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OPTOCHIASMATIC ARACHNOIDITIS*

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CHIASMAL inflammatory lesions produce a syndrome that is similar to that produced by a tumor in the region of the optic chiasm. If suspected, the lesions can be recognized readily by abnormal changes in the cisternae chiasmatis and interpeduncularis after the procedure of air encephalography. Yet, in 1943, Ryan[20] wrote, "there are still too few ophthalmologists who recognize the importance of the disease, its dire consequences to vision if not diagnosed or suspected, and the excellent results that may be obtained by surgical intervention." Ryan[20] and Lillie[16] have stressed the importance of encephalography in making the diagnosis. Although it is well known that the chiasmal region may be involved in generalized arachnoiditis and basal gummatous meningitis, radiologic literature contains very little concerning optochiasmatic arachnoiditis, otherwise described as "chronic cisternal arachnoiditis," "chronic local arachnoiditis," and "chronic circumscribed arachnoiditis of the optic chiasm."

In 1893 Quincke[18] presented generalized arachnoiditis as an entity. A few years later (1898) Schlesinger[22] described localized arachnoiditis. Spiller, Musser and Martin[23] in 1903 reported complete cure after operation on a case with a localized spinal arachnoid cyst. In 1929 Balado and Satanowsky[1] reported a case of optochiasmatic arachnoiditis as a surgical entity, with improvement following operation. Holmes[12] presented 2 cases the same year. In 1937, thirty-seven per cent of 129 reported cases had shown improvement following operation.[2] Others showed no further progression of signs and symptoms. Improvement is less likely in those cases with extensive optic atrophy or intrinsic involvement of the optic nerves by the disease process.

No single cause has been ascribed to optochiasmatic arachnoiditis. Trauma[7,13,14] and infection of the meninges and brain by syphilis,[8,25] mastoiditis,[3] sinusitis,[11,27] petrositis,[3] and chronic rhinopharyngitis[2] have been described as etiologic factors. Bourgeois, *et al.*,[3] believe it may be a sequel of encephalitis, multiple sclerosis, or tuberculosis. It has been described coexisting with Leber's disease[10] and hydatid cyst.[19] In many cases the etiology is never determined. Lillie[17] believes the nonspecific type described by him to be purely inflammatory in nature, chronic in form, with its portal of

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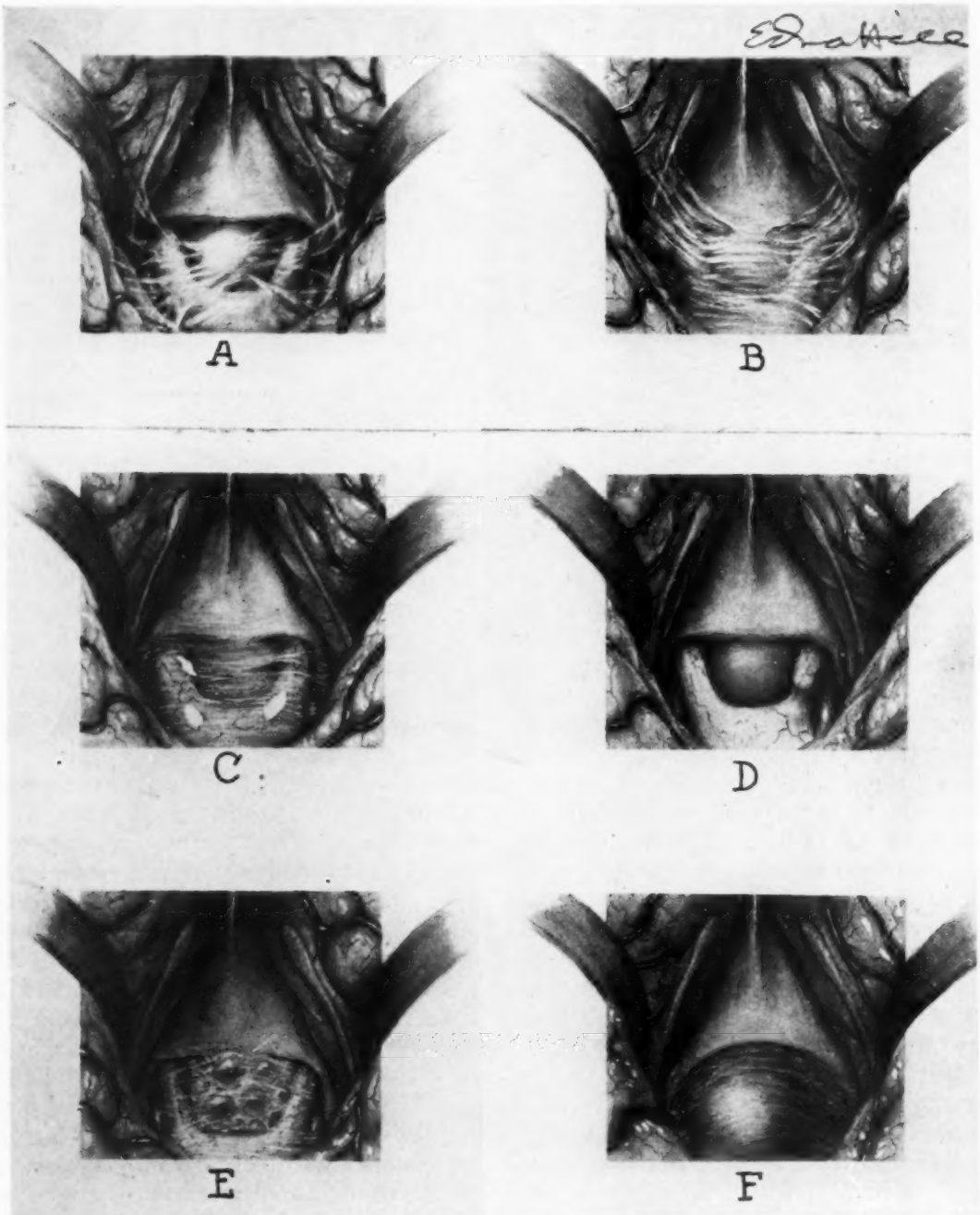

FIG. 1, *A*, *B*, *C*, *D*, *E* and *F*. In (*A*) and (*B*) arachnoid adhesions are shown involving the dorsum sella, optic nerves and chiasm, olfactory nerves, and adjacent brain. In (*C*) there are arachnoid adhesions with calcareous plaques. The adhesions have been removed in (*D*) revealing compression of the right optic nerve and increased vascularity. Types with multiple and single cyst formation are illustrated in (*E*) and (*F*). (Modified from "Les arachnoïdites opto-chiasmatiques" by Bollack, David and Puech, Paris, 1937.)

entry perhaps through the cribriform plate in the anterior fossa.

At operation the arachnoid is thickened, grayish, and opalescent instead of transparent.[11] The cisterna chiasmatis may or may not be distended with cerebrospinal fluid. There may be single or multiple arachnoid cysts[2] and the optic nerves and chiasm appear atrophic and are usually enmeshed in adhesions.[2,4,7] Bollack, David and Puech[2] also described calcareous arachnoid plaques and increased vascularity with venous distention (Fig. 1). The adhesions fix the chiasm and nerves to the base of skull, dura, diaphragm of the hypophysis, adjacent nerves and, more important, adjacent vessels, some of which are pulsating arteries.

Lillie[16] divides the prechiasmal and chiasmal inflammatory lesions, which produce a syndrome suggestive of tumor, into two groups: (1) basal gummatous meningitis and (2) chronic local arachnoiditis. The former is more easily diagnosed with the aid of blood serology and spinal fluid studies which are usually negative in chronic local arachnoiditis. However, the clinical diagnosis of chronic local arachnoiditis is difficult and for this reason the rôle of the roentgenologist is an important one. The patient usually complains only of loss of vision in one or both eyes and headache which is not characteristic but frequently is bifrontal.[20] Rarely there may be signs of pituitary involvement or paralysis of adjacent cranial nerves.

Ophthalmoscopically the fundi may be normal[20] but more often there is optic nerve atrophy. Ten per cent of these patients have choked disks.[2] One of our cases and 2 of Hausman's had choked disks without a significant increase in intracranial pressure.[9] Any type of visual field defect or defects may occur in one or both eyes.[20] Central scotoma, concentric contraction, and temporal loss are the most common observations.[2]

Bollack, David and Puech[2] classify the purely ocular symptomatic forms into three groups: (1) the syndrome of axial neuritis (25 per cent); (2) the syndrome of simple atrophy (13 per cent); (3) the chiasmal syndrome (15 per cent). The remaining 47 per cent have atypical ocular lesions or involvement of adjacent structures of the brain. The chiasmal syndrome alone, i.e. primary optic atrophy with bitemporal field defects, may, according to Hausman,[8] be produced by: (1) suprasellar cysts or tumors; (2) tumor, syphilis[15] and hemorrhage into the pituitary body; (3) parasellar lesions such as chronic cisternal arachnoiditis, aneurysms, tumors of the optic chiasm, optic nerve, olfactory groove or sphenoid ridge, trauma of the chiasm, oxycephaly, and heredodegeneration (Leber's disease). Other entities to be ruled out include third ventricle and posterior fossa tumors,[26] multiple sclerosis, neuromyelitis optica, encephalitis, retrobulbar neuritis, toxic amblyopia, and syphilitic optic atrophy without arachnoiditis.

The patient in the past usually has been referred to the roentgenologist by the ophthalmologist, neurologist, or neurosurgeon to demonstrate evidence of a brain tumor. Conventional roentgenograms of the skull and optic canals of patients who do not have brain tumors or increased intracranial pressure, but who do have ocular signs or symptoms of optochiasmatic arachnoiditis usually show nothing abnormal. There may be evidence of sinusitis which can be significant etiologically.[24]

If the conventional roentgen examination shows nothing abnormal in such patients, it is important for the roentgenologist to emphasize the possibilities of air encephalography. Lillie[16] has reported 3 cases in which the correct pathologic process was predicted after air encephalography. We have observed the conditions several times, our first proved case being in October, 1935.

Before discussing the encephalographic changes in the region of the diseased optic chiasm, we shall review the normal appearance of this region. The arachnoid and pia mater membranes covering the spinal cord, the brain, the hypophysis and the intracranial nerves are generally in close ap-

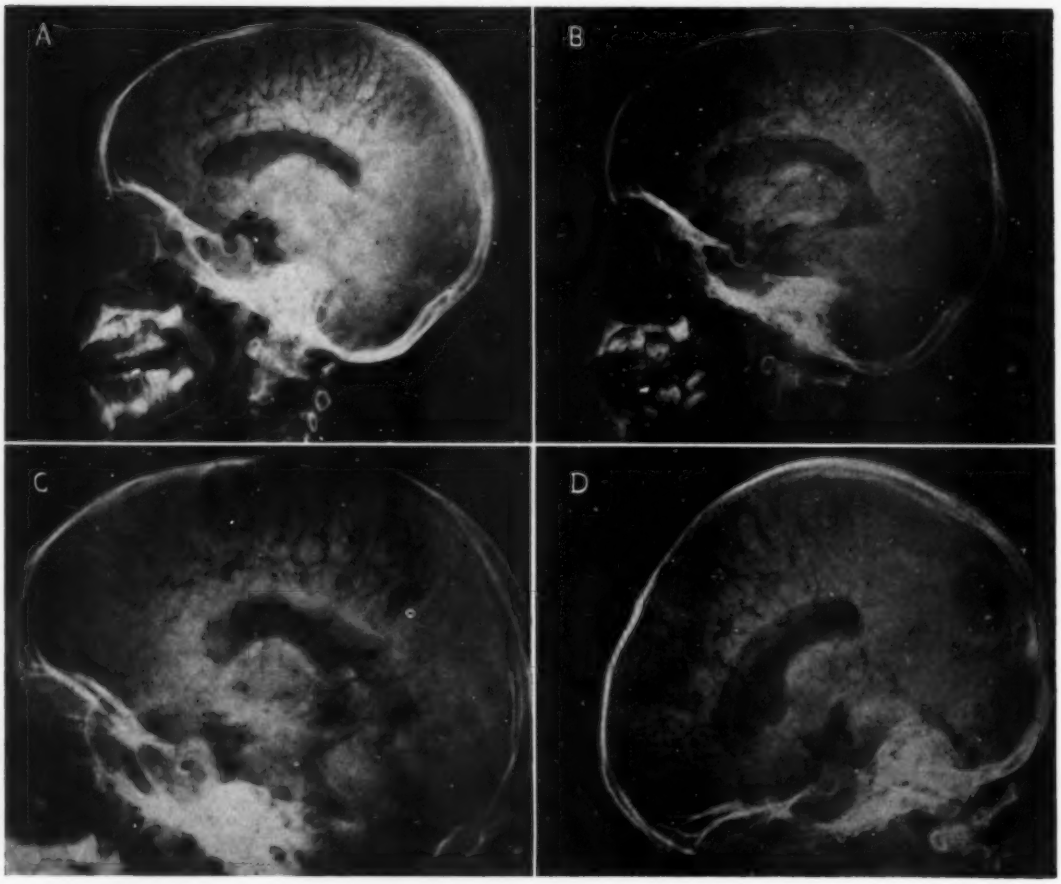

FIG. 2, *A*, *B*, *C* and *D*. Encephalogram illustrating appearance of the cisternae chiasmatis, interpeduncularis and pontis in the erect lateral position (*A*), in the horizontal lateral position (*B*), and in the prone (*C*) and supine (*D*) positions. In illustrations (*A*) and (*D*) the cisternae shadows around the hypophyses are seen better than in (*B*) and (*C*).

position with the dura mater except over the cerebral sulci and the cisternae at the base of the brain. The cisternae are formed by a wide separation of the arachnoid and pia mater. Encephalographic procedures may outline the cisternae magna, chiasmatis, interpeduncularis, pontis, lamina terminalis, ambiens, fossae of Sylvius, and the corpora callosi.

In this presentation we are concerned most with the chiasmatis, interpeduncularis, and pontis. In the so-called normal encephalogram there is some variation in the size and shape of these cisternae depending largely upon the position of the optic chiasm, the neighboring structures and the conformation of the base of the skull and the position in which the roentgenograms are made. For instance, if the lateral roentgenograms are made in the erect posture, one may see the shadows of the basal cisternae around the hypophysis and their contained structures, whereas if the roentgenograms are made with a vertical beam in the horizontal posture the contained structures in the cisterna chiasmatis may be entirely or incompletely obscured (Fig. 2*B*). If one uses a horizontal beam to make lateral roentgenograms of the head with the patient lying first on the abdomen and then on the back, one observes that the air in the cisternae around the hypophyses changes position with change in posture and oftentimes provides

an opportunity for obtaining additional information to that secured in the erect roentgenograms (Fig. 2, *C* and *D*).

Most of the cisterna chiasmatis lies between the diverging optic nerves. It extends laterally as far as the carotid arteries, communicating ventrally with the cerebral artery may be outlined in the superior portion of the cisterna chiasmatis (Fig. 4). Beneath and posterior to the anterior communicating artery, about 1 cm. above the sella turcica is a 3–4 mm. ovoid shadow representing the optic chiasm. The position of the optic chiasm is

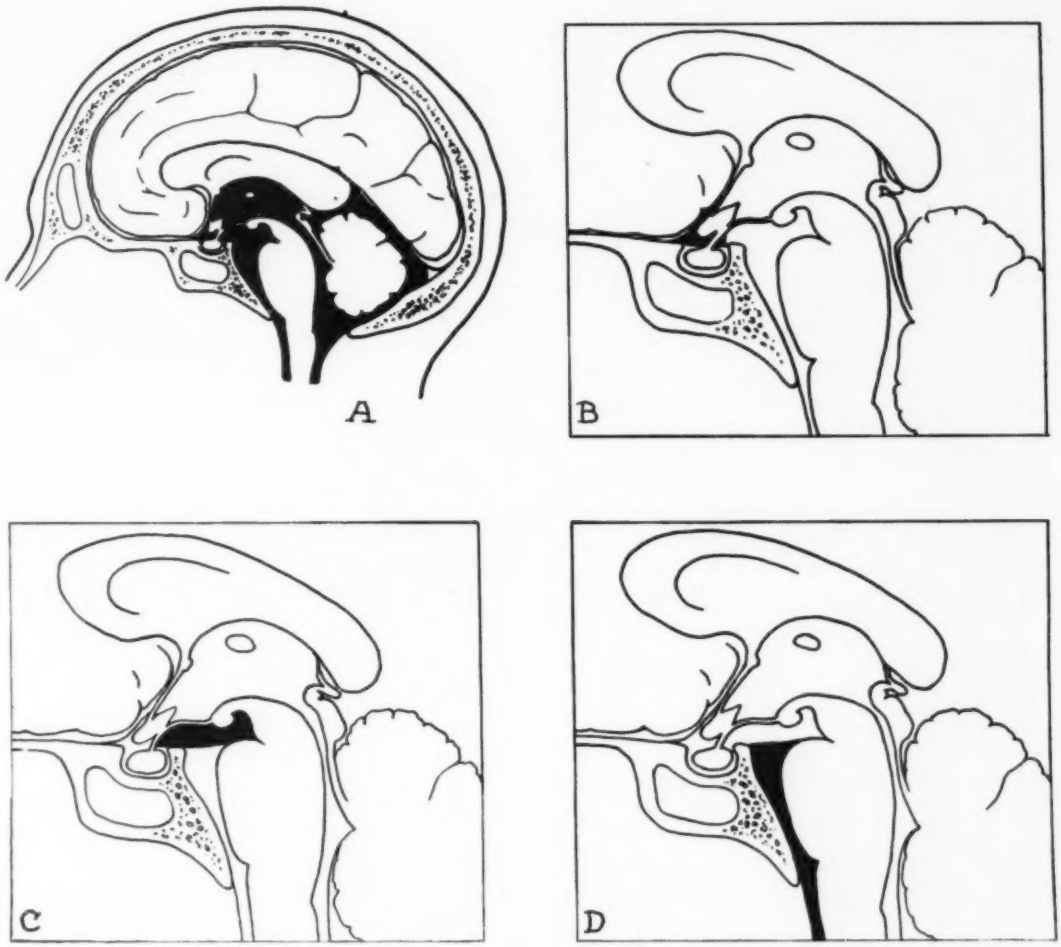

Fig. 3, *A*, *B*, *C* and *D*. Schematic drawing of the basal cisternae (*A*), including the cisternae chiasmatis (*B*), interpeduncularis (*C*), and pontis (*D*).

hypophyseal subarachnoid space and with the cisterna interpeduncularis posteriorly beneath the optic chiasm (Fig. 3). That portion of the cistern anterior to the chiasm is usually visualized, while the lateral extensions around the optic nerves are less frequently seen.[6] The anterior communicating artery and occasionally the middle quite variable. Schaeffer[21] states that in his study 5 per cent were located anteriorly on the chiasmatic sulcus, the remaining portion resting upon the diaphragma sellae. Twelve per cent were wholly located over the diaphragma sellae, while in 79 per cent the optic chiasm was almost completely over the diaphragma sellae, a small portion

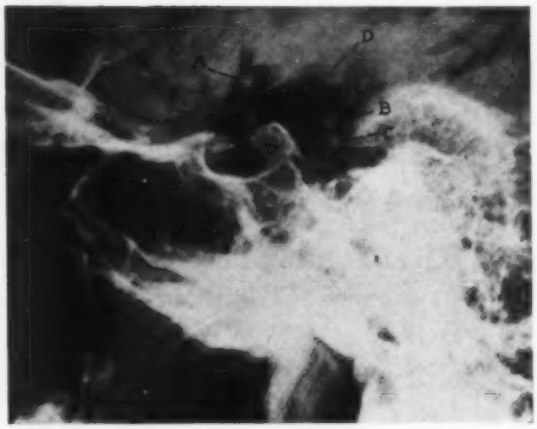

FIG. 4. The shadows of the anterior communicating artery can be seen at (*A*), the posterior cerebral artery at (*B*), the superior cerebellar at (*C*), and the mammillary bodies at (*D*).

projecting on to the dorsum sellae. In 4 per cent, the chiasm was located on and posterior to the dorsum sellae. The optic nerves can be seen extending obliquely downward and forward across the cisterna (Fig. 5). The infundibulum of the hypophysis is more posterior, running at a sharper angle forward and downward to the diaphragma sella (Fig. 6). Above the diaphragma sella the chiasmatis communicates with the cisterna interpeduncularis.

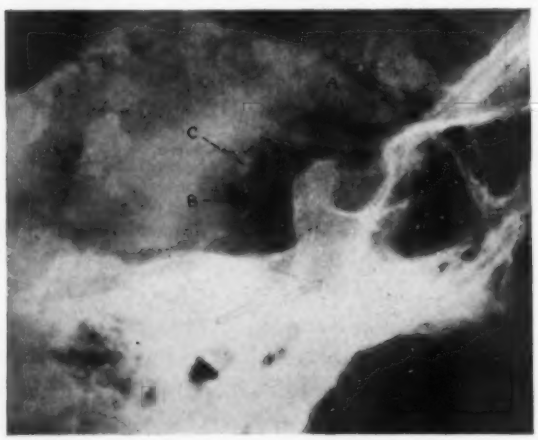

FIG. 5. The shadows of the optic chiasm and nerves can be seen at (*A*). The basilar and posterior cerebral arteries are seen at (*B*) and (*C*), respectively.

In the lateral view, the cisterna interpeduncularis is limited anteriorly by the infundibulum, optic chiasm, and tuber cinereum. The posterior border is formed by the pons, and the cerebral peduncles

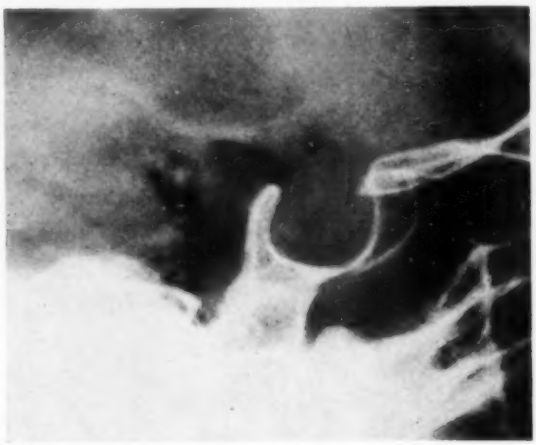

FIG. 6. A case of basal arachnoiditis in which the thickened arachnoid accentuates the outline of the infundibulum.

FIG. 7. Shadows which may represent the oculomotor nerves or vascular structures can be seen at (*A*) and (*B*).

limit the cisterna above and somewhat posteriorly. A portion of the diaphragma sellae, the dorsum sellae, and the cisterna pontis limit the interpeduncularis below. Anteriorly and below the peduncles, the corpora mammillaria project into the cisterna. This shadow is round and 4–5 mm. in diameter. The tuber cinereum is

seen as a straight line slanting down from the corpora mammillaria to the optic chiasm (Fig. 4). The oculomotor nerves run in the lateral walls of the cistern and occasionally may be seen running forward and slightly downward across the cistern, disappearing behind the sella (Fig. 7). In the posterior portion of the cistern the posterior cerebral arteries may also be visualized as they branch from the basilar. Beneath this the superior cerebellar arteries can be seen (Fig. 4).

Beneath and in direct communication with the cisterna interpeduncularis the cisterna pontis is bounded by the dorsum sellae and pons (Fig. 3). The most readily visible structure within it is the basilar artery (Fig. 8). The trigeminal, abducens, facial, and acoustic nerves cross the cisterna but are not readily visible.

One cannot be dogmatic in his interpretation of the structures seen in the above described cisternae, for there are several shadows, often visible, which have not been included in classical descriptions of the structures seen in these cisternae after encephalography. The internal carotid artery is often described when calcified but is otherwise not mentioned. In the "normal" encephalogram there is occasionally a curvilinear shadow posterior to and merging with the dorsum sellae (Fig. 9*A*).

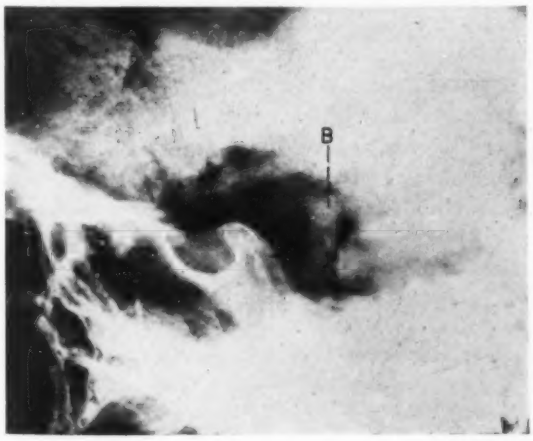

Fig. 8. The shadow of the basilar artery is well visualized at (*A*) and the posterior cerebral artery at (*B*).

This shadow cannot be seen on the plain roentgenograms (Fig. 9*B*) but comparison with an arteriogram in the same patients

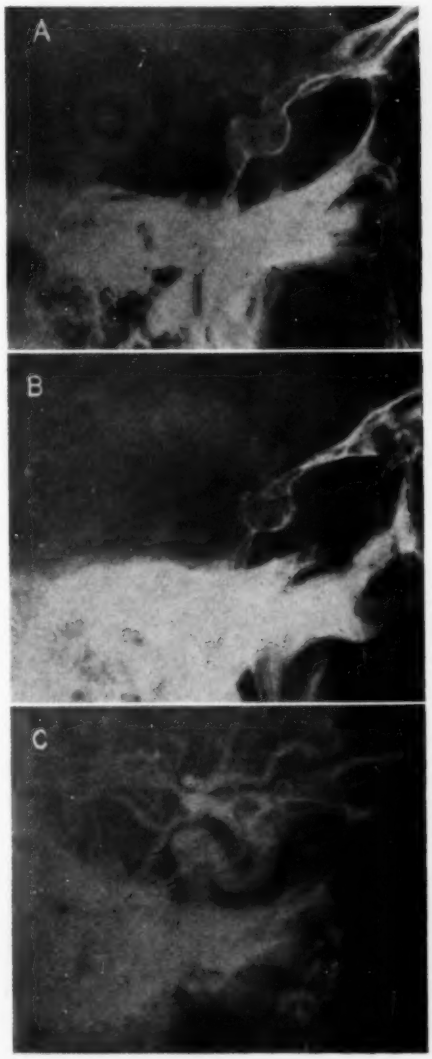

Fig. 9, *A*, *B* and *C*. The shadow of the internal carotid can be seen in the encephalogram (*A*). It is not visible in the plain roentgenogram (*B*). The arteriogram (*C*) verifies its position in relation to the sella.

(Fig. 9*C*) lead us to believe the shadow is the internal carotid artery which ascends towards the posterior clinoid processes, curves forward before reaching them, pierces the external layer of the dura mater,

and enters the outer wall of the cavernous sinus. It continues forward in the sinus as far as the anterior clinoid processes nda tuberculum sella. At that point it bends upward through the inner layer of the dura. It then passes backward forming a U-shaped curve, "le siphon carotidien," and pierces the arachnoid to divide into its terminal branches, the anterior and middle cerebral arteries. Examination of normal encephalograms reveals an undescribed shadow ascending obliquely across the cisternae chiasmatis and interpeduncularis (Fig. 10). An arteriogram performed on one of these patients (Fig. 10*C*) reveals this shadow to be coincident with the upper arm of "le siphon carotidien" or U-shaped curve of the internal carotid artery. This shadow may be confused with the infundibulum (Fig. 6) but is more anterior and much larger. Less often it may be confused with the optic chiasm and nerves. One must also distinguish it from adhesions such as will be described below in cases of optochiasmatic arachnoiditis.

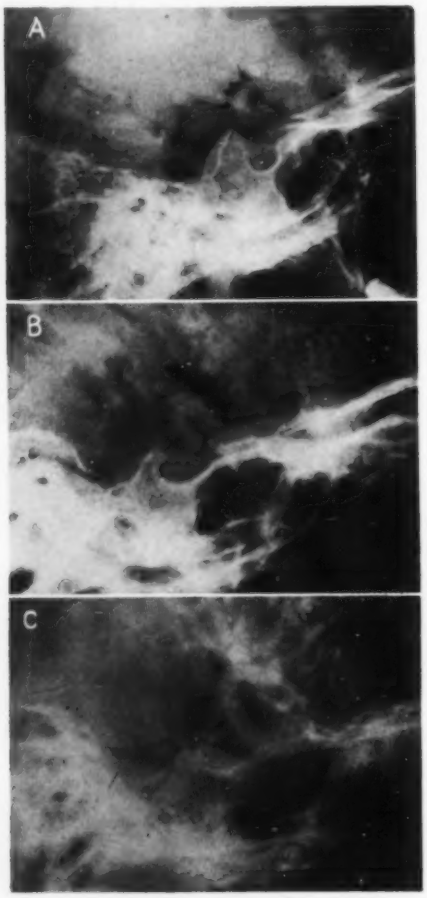

FIG. 10, *A*, *B* and *C*. The internal carotid is well visualized in (*A*) and (*B*). An arteriogram (*C*) verifies the position of the shadow seen in (*B*).

The encephalographic findings in optochiasmatic arachnoiditis are rather typical, if the cerebrospinal system is well drained of fluid and replaced with air through the lumbar route. When the cisternal route is employed the basal cisternae are not seen well in the encephalogram. The shadows of the cisternae chiasmatis and interpeduncularis can be readily demonstrated in most individuals who have no symptoms referable to that region. In the presence of optochiasmatic arachnoiditis the clear air shadows of the cisterna chiasmatis, occasionally the cisternae interpeduncularis and pontis, are absent, deformed or encroached upon, and the structures usually seen within the cisternae cannot be identified. The neuroroentgenologist is likely to describe the appearance as due to a tumor. There is ample justification for such a diagnosis because, for the most part, we have not suspected that localized areas of arachnoiditis were likely to occur there and were capable of producing a syndrome similar to that produced by a tumor. We now know that such an appearance may be produced by a localized chiasmal arachnoiditis, and should be considered always in arriving at the final diagnosis.

REPORT OF CASES

Only significant findings are included in the following case summaries.

CASE 1. The patient was a single, white male, aged twenty, dental laboratory worker, admitted September 25, 1935, with a chief complaint of loss of vision for eight months. Past history revealed occupational exposure to small amount of nitric acid, lead, zinc, gold, silver, and acetone. His present illness began one year previ-

ous to admission with diarrhea of three months' duration, which was followed by an attack of chills and slight fever, diagnosed "influenza" and sinusitis. Six days later he developed generalized shaking and numbness lasting one month, at the end of which he lost the vision of his right eye. One month later he suffered an attack of numbness of his lower legs lasting two weeks and the vision of his left eye slowly decreased.

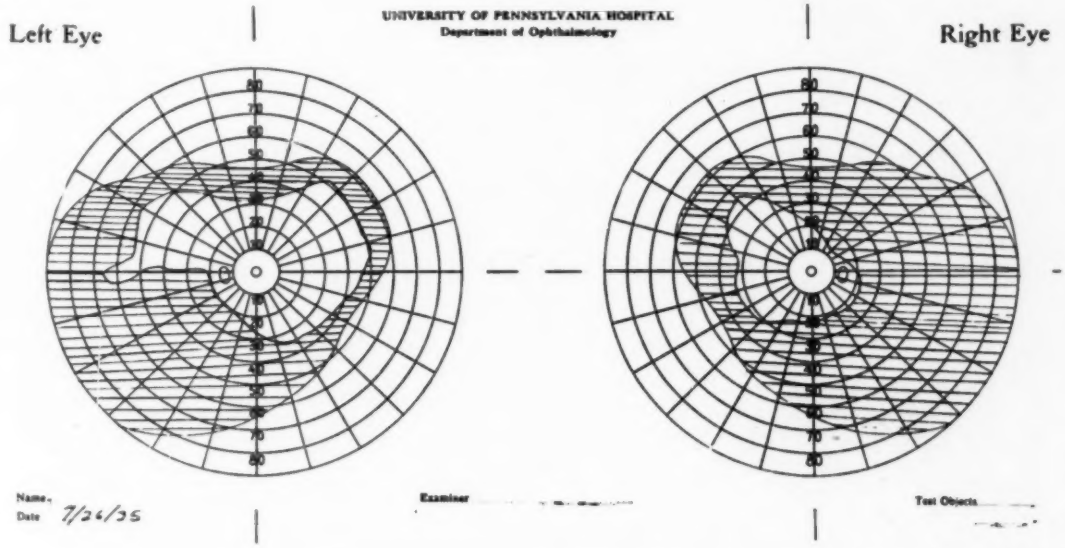

Fig. 11. Case 1. Visual fields showing bitemporal hemianopsia and contraction of the nasal fields.

Physical examination revealed the liver and spleen to be palpable with deep inspiration. There was bilateral loss of vision, his visual acuity being 1/60 in the right eye and 6/60 in the left. Bilateral optic atrophy with contraction of the nasal fields and bitemporal hemianopsia (Fig. 11). and hyperesthesia of the third portion of right trigeminal nerve were also noted.

Laboratory studies including the blood Wassermann and spinal fluid were negative. Sinus roentgenograms showed mucous membrane thickening, most marked in the ethmoids. An air encephalogram revealed lack of visualization of the cisterna chiasmatis, the left ventricle was slightly larger than the right, and the cortical markings of the left cerebral hemisphere were less prominent than those on the right (Fig. 12).

A right transfrontal craniotomy was subsequently performed on October 15, 1935, and a number of firm arachnoid adhesions were found along the optic nerves and extending over the anterior surface of the chiasm. These were carefully separated giving a good exposure of the entire region which contained no evidence of a mass lesion. The optic nerves and internal carotid arteries were in unusually close contact.

On July 22, 1936, the patient's visual acuity and visual fields remained about the same or very slightly better. He was advised to enter the hospital for an encephalogram and possibly an-

Fig. 12. Case 1. The cisterna chiasmatis and upper portion of the cisterna interpeduncularis are obscured.

other operation. His vision changed little during the next few years. He returned again January 19, 1944, because his Selective Service Board would not believe he was blind and was about to induct him into the Army. He was last seen June 21, 1944, stating he had become completely blind four days before. He was extremely tense and nervous. Neurological examination was completely negative, although he had noted occasional difficulty starting his urinary stream. He was referred to the eye service as a possible multiple sclerosis.

Comment. In this patient the cisterna chiasmatis is encroached upon above the chiasm and the superior portion of the cisterna interpeduncularis is also distorted (Fig. 12). Lillie's cases usually had compensatory subarachnoid channels in the frontal and occipital poles and the pathways around the islands of Reil were enlarged. It does not seem likely that the slight asymmetry of ventricles and cortical markings noted in this patient are related to the chiasmal lesion. Worthy of further note is the observation that the optic nerves were bound down by adhesions in close contact with the carotid arteries, suggesting a possible mechanism for some of the optic nerve changes.

CASE II. The patient was a white male aviator, aged forty, married, admitted on March 9, 1940, complaining of loss of visual acuity for one and a half years. Eighteen months before admission he noticed dimness of vision in his left eye which cleared after several months' rest. A few months later dimness returned in the left eye and soon after in the right eye. Three months before admission he noticed increased prominence of his right eye.

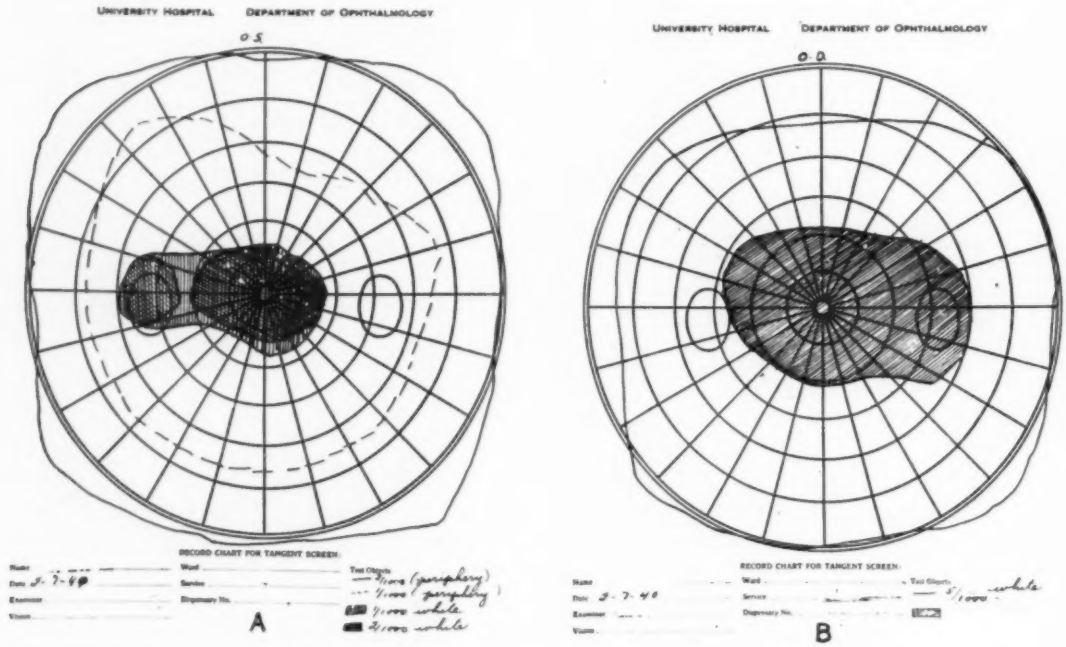

FIG. 13, *A* and *B*. Case II. There is a cecocentral scotoma in the left eye (*A*), and bilateral central scotoma (*B*).

Physical examination revealed widening of the right palpebral fissure with exophthalmos on the right and bilateral loss of vision. Visual acuity in the right eye was 1/60 and in the left eye 6/60. The right disk was pale with a blurred margin. The optic cup was filled with connective tissue, and several perivascular sheaths were present. The left disk was similar but less marked. There were bilateral central scotomata and also a cecocentral one on the left, but the peripheral fields were only slightly contracted (Fig. 13, *A* and *B*).

Laboratory studies and roentgenograms of skull, orbits, and sinuses were negative.

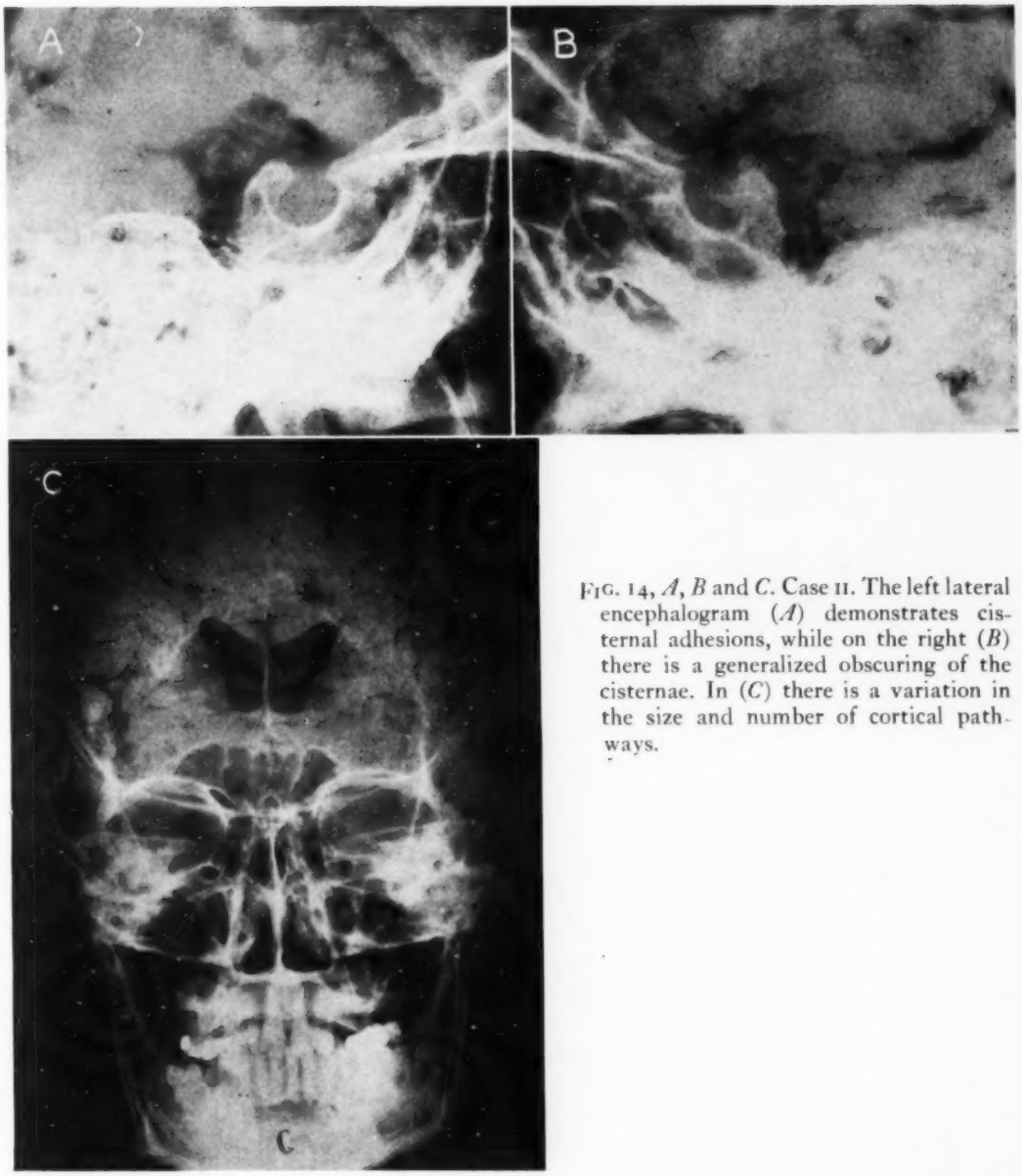

Fig. 14, *A*, *B* and *C*. Case 11. The left lateral encephalogram (*A*) demonstrates cisternal adhesions, while on the right (*B*) there is a generalized obscuring of the cisternae. In (*C*) there is a variation in the size and number of cortical pathways.

An air encephalogram revealed the ventricular system to be slightly enlarged. The cortical pathways in the frontal and parietal regions were increased in prominence, and in the region of the vertex there was an absence of pathways which was believed due to incomplete drainage or arachnoiditis. The shadows of the cisternal chiasmatis and interpeduncularis were definitely abnormal (Fig. 14, *A* and *B*)

A right transfrontal craniotomy was performed on March 11, 1940, revealing the optic nerves enmeshed in unusually thick and tough adhesions which could not be separated by dissection, but had to be cut with scissors. The optic nerves were thin, yellowish, and somewhat atrophic. The sella was entirely normal. The pituitary gland was not enlarged, and an excellent view of the pituitary stalk was obtained. Except for the presence of the marked adhesions, this region was entirely negative. Removal of the roof of the right orbit revealed no intraorbital tumor.

Re-examination January 15, 1941, revealed the patient's vision to be about the same with-

out improvement or sight loss. His visual acuity was 1/70 in the right eye and 20/70 in the left eye uncorrected.

Comment. Occasionally the roentgenologist may note that one side of the cisterna appears more extensively involved. In the above case the cisternae chiasmatis and interpeduncularis appear to be obscured more on the left, but clinically there was less involvement on this side. The difference may be explained by a pathological difference in the lesion on the two sides. On the left side numerous band-like structures can be seen crossing the cisternae, some of which may represent adhesions, the appearance is similar to that illustrated in Figure 1*B*. On the right there is a more uniform obscuring of the cisternae which may be due to a diffuse thickening of the arachnoid with or without cystic changes. The cisterna pontis is also obscured (Fig 14, *A* and *B*).

These changes were at first not observed by a junior member of the staff, further illustrating the necessity of suspecting the syndrome in patients with signs of optic nerve involvement. The roentgenologist should also make certain there has been adequate drainage of the spinal fluid by noting whether or not it has been removed from the spinal subarachnoid spaces and basal cisternae.

CASE III. This thirty-six year old white male was first seen in the eye clinic on June 13, 1944, complaining of visual loss for three months.

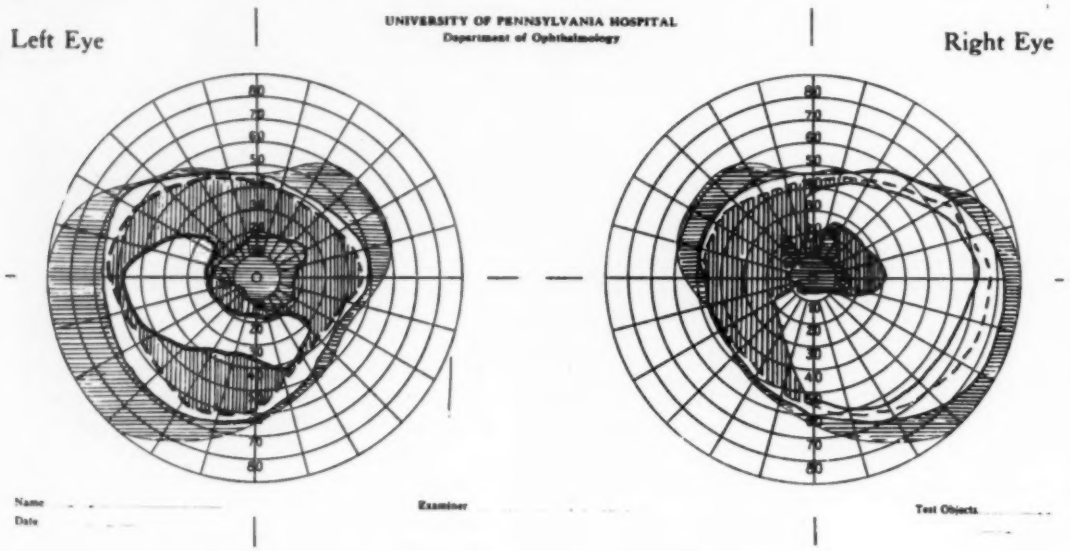

FIG. 15. Case III. This shows bilateral central scotomata.

Visual acuity at that time was 6/15 O. D. and 1/150 O. S., with correction. The left optic nerve was atrophic and the right blurred and very slightly elevated. Visual fields showed large central scotomata in the left and a very small one in the right which were not localized (Fig. 15).

He was admitted to the eye ward on June 28, 1944, because his visual loss was progressive. At this time his vision was 6/60 O. D. and 3/180 O. S. There was increased edema of the right nerve head, overfilling of the veins, and small hemorrhages near the disk, as well as atrophy of the left optic nerve (Foster Kennedy syndrome). Visual fields now, in addition to the central scotomata, showed a superior quadranopsia which was incongruous. Except for a partial anosmia, physical examination was negative.

Roentgenographic studies revealed a suspicious tooth in the left maxillary region. Negative studies included a nose and throat consultation, chest, skull, and sinus roentgenograms, blood count, urine, serology, routine agglutinations, and spinal fluid. A pneumo-encephalogram

revealed lack of filling of the chiasmal subarachnoid cistern. The clinical diagnosis was a lesion in the left optic tract just behind the chiasm.

On September 26, 1944, he complained of continued loss of vision. His visual acuity was 3/120 O. D. and 1/120 O. S. The left optic nerve was still pale and the right one continued to show choking. There was pallor of the temporal portion of the right nerve head. Visual fields showed the large central scotomata with a binasal color cut.

A craniotomy on October 4, 1944, revealed both optic nerves were very definitely bound down to the sella by solid adhesions of grayish, thickened arachnoid. The adhesions were carefully cleaned away and a small fragment was taken for study.

Eight days, postoperative, his ocular status was believed to be worse. How much of this was functional and due to operative edema remained to be seen. Three weeks postoperative there was slight but definite improvement.

Comment. In this case the air shadow normally seen above the optic chiasm is obscured. Here also, as in the second case, the adhesions themselves can be seen as faint linear strands extending across the cisternae interpeduncularis and chiasmatis, obscuring the cisternae and the structures within them (Fig. 16).

Fig. 16. Case III. Arachnoiditis obscuring the cistenae chiasmatis and interpeduncularis.

Case IV. This was the third admission, December 3, 1941, of a forty-seven year old white mill-hand, complaining of "crossed eyes" and poor vision for three years. His past history revealed a head injury involving transitory loss of consciousness at the age of ten. Four years before this admission (1937), he began to notice a progressive diminution in his sense of smell and shooting pains appeared in various parts of his body. The following year his eyes began to cross and his vision became blurred. His doctor also told him he had a right facial paralysis. Two years ago a doctor took roentgenograms and told him he had a "tumor pressing the optic nerves." Soon after, he entered this hospital (March 28, 1940) where loss of olfactory sense,

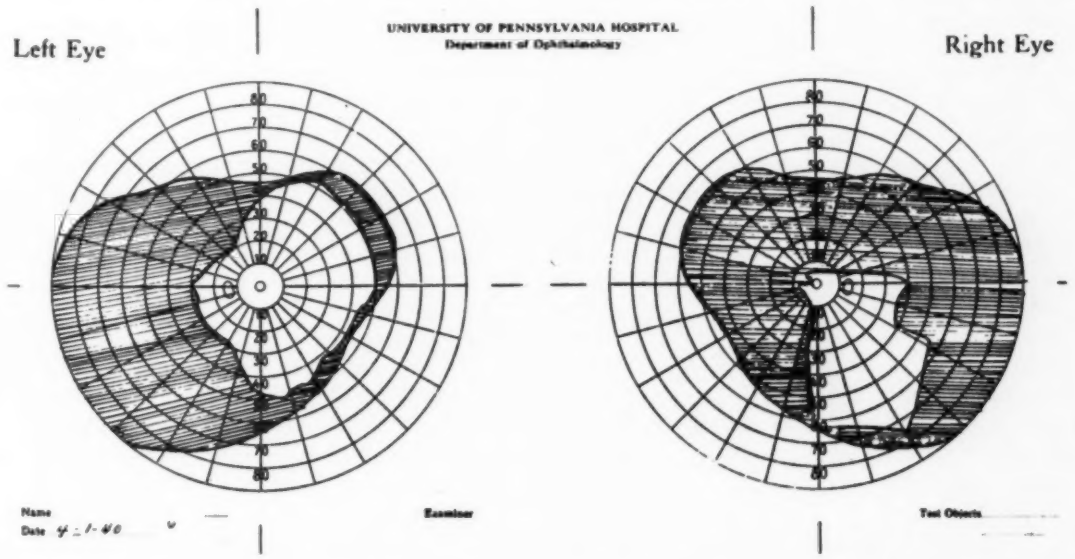

Fig. 17. Case IV. This shows a bilateral hemianopsia with contraction of the right nasal field.

FIG. 18. Case IV. Poor visualization of the cisternae chiasmatis and interpeduncularis due to basal arachnoiditis.

abducens nerve paralysis, dilated fixed pupils, and bilateral primary optic atrophy, worse on the right, were noted. His vision was 6/60 O. S. but he was able only to count fingers at 1 foot with the right (Fig. 17). Subsequent significant studies: blood Wassermann weakly positive and negative, cerebrospinal fluid Wassermann medium positive on two occasions. Head roentgenograms revealed a nasopharyngeal tumor which on biopsy was lymphoid hyperplasia. Luetic therapy was begun on April 5, 1940, and he was discharged temporarily.

On February 11, 1941, he was readmitted. Although he had improved generally under luetic therapy, he had developed a slight stagger when walking and his vision had become progressively worse. At this time he had light perception only in the right eye and a left temporal hemianopsia. His spinal fluid Wassermann was more positive and the gold curve 4444444410. An encephalogram revealed bilateral cortical atrophy and poor visualization of the cisternae interpeduncularis and chiasmatis, possibly due to basal arachnoiditis (Fig. 18).

He was last admitted December 3, 1941, with a diagnosis of chiasmal arachnoiditis. A craniotomy was performed on December 5, 1941. A bluish mass (large vein) was first noted near the lateral side of the right optic nerve which on needling contained only blood. The chiasm was then exposed and many fine adhesions between the optic nerves and dura were cut so that the chiasm was freed.

Re-examination on April 14, 1942, revealed he could see hand movements only in the right eye with correction, and in the left eye visual acuity was 6/60. His pupils and fundi were unchanged. On November 22, 1943, he was again seen and his visual acuity, fundi, and fields were unchanged.

Comment. We have included this case as an illustration of a chiasmal arachnoiditis with specific etiology, namely syphilis. Ten per cent of Bollack's cases had positive blood and/or spinal fluid Wassermann reactions.[2] The clinician and roentgenologist must be cognizant of this possibility when examining syphilitics with eye symptoms. Hausman[8] has emphasized that visual field defects and optic atrophy in syphilitic patients do not, in the absence of other neurologic signs, necessarily denote tabes. In his opinion, syphilitic basilar meningitis is much more frequent than generally supposed. The roentgenologist may in the future contribute much to the proof or disproof of this belief (Fig. 18).

CASE V. This was a forty-one year old woman complaining of failing vision for four years. Her past history revealed pneumonia in childhood, rheumatic fever at seventeen, an appendectomy four years before, and radium implantation for uterine fibroids four months before.

Four years before admission on November 5, 1941, the vision in her left eye began to fail and progressed to light perception only. The vision in the right eye began to fail four months prior to admission. Significant physical findings were limited to the eyes. There was light perception only in the left eye and 6/30 vision in the right eye with only slight contraction of the field. The light reflex on the right was absent but the consensual reflex was present. The left optic disk was atrophic, and the temporal half of the right disk slightly pale.

An encephalogram was interpreted arachnoiditis, cortical atrophy, and a possible mass lesion in the chiasmal region (Fig. 19, *A* and *B*).

On the third day of admission a small suprasellar meningioma involving the sella turcica and springing from the left olfactory groove was incompletely removed because of its proximity to the carotid arteries. The right optic nerve was freed from its involvement by the tumor.

She was re-examined March 18, 1942, as an out-patient. There was little vision in the left eye, the vision in her right was improved to 6/9 and the visual field was full.

Comment. This patient is a good example of the occasional tumor case in which it is not only difficult to differentiate between tumor and arachnoiditis before but also after encephalography. If the sella turcica is enlarged or eroded, one should immediately suspect a tumor. In this instance a rather large shadow in the region of the optic chiasm was noted and the correct diagnosis was made (Fig. 19*A*).

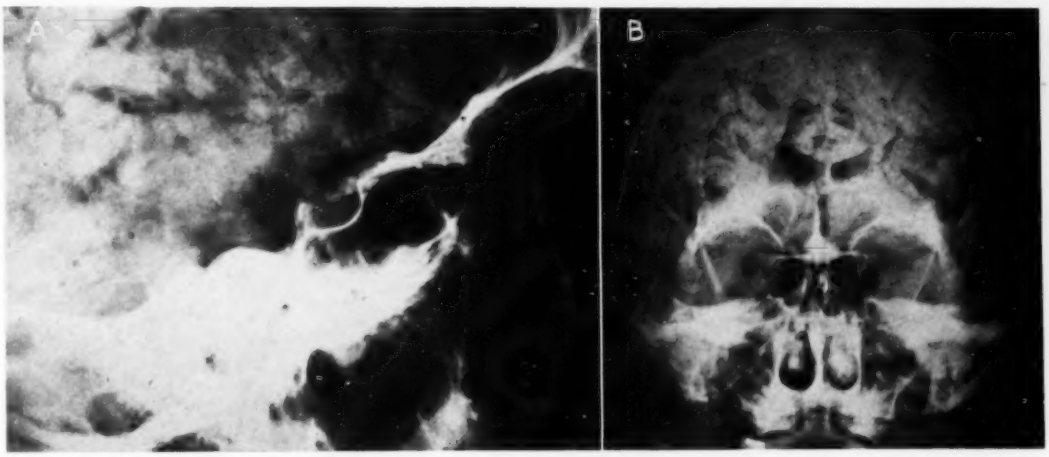

Fig. 19, *A* and *B*. Case v. Distortion of the cisterna chiasmatis by a suprasellar meningioma (*A*), with concomitant arachnoiditis and cortical atrophy (*B*).

This case, as well as the second, illustrates the necessity of evaluating carefully the structures in the region of the cisterna chiasmatis. Another interesting feature is that the tumor was small enough not to block the midline and lateral subarachnoid pathways.

We do not wish to convey the impression that every distortion of the encephalographic appearance of the cisternae in the region of the optic chiasm is necessarily pathognomonic of a disease or tumor involving the optic nerves or tracts or the adjacent structures. We do wish to emphasize the importance of recognizing the normal pattern and its normal variants.

There is another group of patients usually referred to the roentgenologist for encephalography because of jacksonian epilepsy. These patients have no eye signs or symptoms but the appearance of the air study is suggestive of generalized or basal arachnoiditis with poor visualization of the basal cisternae and subarachnoid pathways over one or both hemispheres. Usually there is also some degree of hydrocephalus.

Case vi. The patient was a twenty-two year old girl whose only symptom was attacks of jacksonian convulsions involving the right side of the body for one year. Physical examination revealed infected tonsils, slight deviation of the tongue to the right upon protrusion, slight ptosis of the right eyelid, and greater activity of the tendon reflexes on the right side. There were no eye signs or symptoms. An encephalogram was done revealing moderate dilatation of the ventricular system and almost complete lack of filling of the subarachnoid pathways. The cisterna chiasmatis is apparently obliterated and the cisterna interpeduncularis is encroached upon (Fig. 20*A*). A craniotomy was performed and a blood clot, microscopically fresh in appearance, was removed. An encephalogram performed nine months later showed better, but irregular, filling of the cisternae chiasmatis and interpeduncularis (Fig. 20*C*).

Case vii. The patient was a boy, aged sixteen, with convulsions involving the left side of the body and mental retardation for thirteen years. He had a severe attack of "brain fever" in infancy. Complete examination revealed only mental retardation. The encephalogram (Fig. 21) shows slight dilatation and asymmetry of the lateral ventricles and absence of air in the subarachnoid pathways over the cortex.

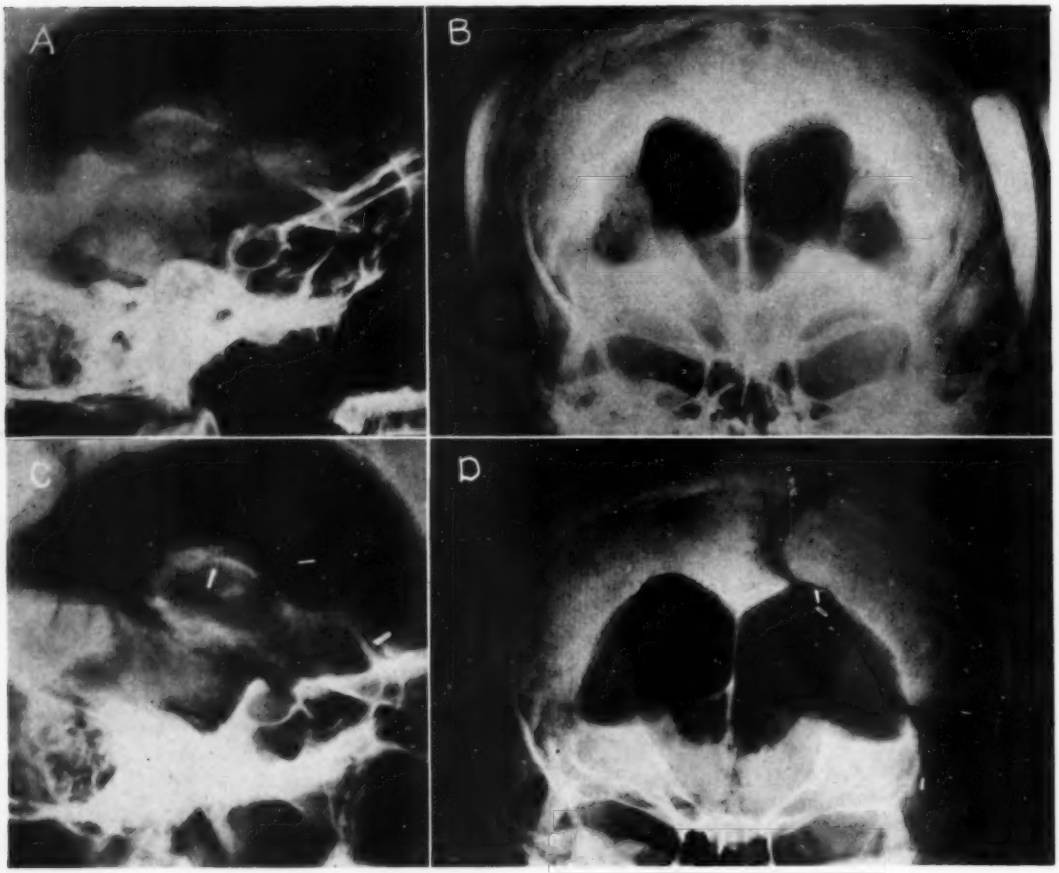

FIG. 20, *A*, *B*, *C* and *D*. Case VI. The cisternae chiasmatis and interpeduncularis are almost completely obliterated (*A*), and there is little filling of the subarachnoid pathways (*B*). There is better filling after operation (*C*) and (*D*).

The cisternae chiasmatis and interpeduncularis are encroached upon by a homogeneous shadow appearing continuous with the surrounding structures.

CASE VIII. The patient was a male, aged fifty, who had been exhibiting personality changes for twenty-five years and jacksonian convulsions for fifteen years. He had been kicked in the head by a horse and severely injured at ten years of age. Complete examination revealed only infected tonsils and teeth. The encephalogram (Fig. 22) revealed few subarachnoid pathways and the cisternae chiasmatis and interpeduncularis were blurred and distorted. A

FIG. 21. Case VII. There is uniform encroachment upon the cisternae chiasmatis and interpeduncularis with absence of subarachnoid pathways.

small amount of air was trapped in the posterior horn of the lateral ventricle simulating somewhat the appearance of a cyst communicating with the ventricle.

Comment. The roentgenographic appearance described in Cases VI, VII, and VIII is typical of either generalized arachnoiditis or basal arachnoiditis causing obstruction of the flow of cerebrospinal fluid from the basal cisternae and the foramina of Magendie and Luschka of the fourth ventricle which in turn results in dilatation of the ventricles and prevents filling of the subarachnoid pathways. When the roentgenologist is confronted with cases such as these without eye symptoms, he should recommend ophthalmoscopic and visual field studies if they have not already been done.

Case IX. The patient was a male, aged fifty-eight, who had received severe head trauma one year before admission. Six weeks after the accident he began to have headaches in the region of the left temple and noticed numbness and weakness in the right hand and foot which progressed to his shoulder and hip. Examination revealed impaired intellect, right hemiparesis, mild arteriosclerosis, and pulmonary emphysema. The encephalogram (Fig. 23) shows slight enlargement of the lateral ventricles, greater on the left. There are fewer subarachnoid pathways over the left frontoparietal region and the cisternae chiasmatis and interpeduncularis are poorly visualized.

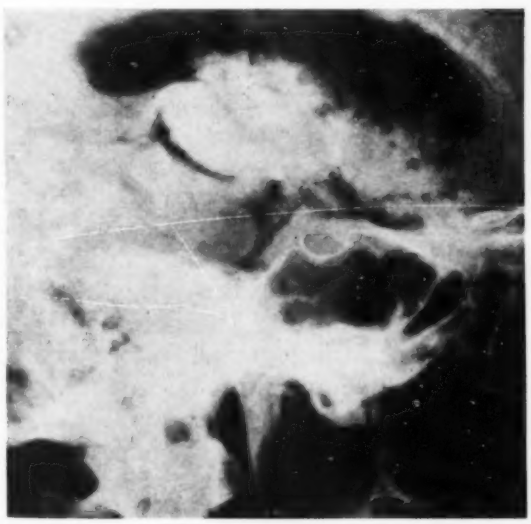

Fig. 22. Case VIII. There is blurring and distortion of the cisternae with few subarachnoid pathways.

Fig. 23. Case IX. The cisternae are poorly visualized but there is inadequate drainage of cerebrospinal fluid.

Comment. This patient could have a localized arachnoiditis or a basal arachnoiditis which has interfered with drainage of the spinal fluid from the subarachnoid pathways. However, the interpretation of the appearance of the cisternae must be qualified for *it is most important to note there is poor visualization of the fourth ventricle and no air in the spinal subarachnoid spaces, indicating inadequate drainage of the spinal fluid previous to air injection.*

Case X. This patient was a six year old boy who had had two jacksonian convulsions during the preceding four months. Neurological examination was negative and as in Cases VI, VII, VIII, and IX, there were no eye signs or symptoms. An electro-encephalogram was indicative of a focal lesion in the left temporal region. There is a reduction in the number of subarachnoid pathways in the encephalogram (Fig. 24) and the cisterna chiasmatis is not seen.

Comment. It is obvious that the spinal fluid drainage has been incomplete for the

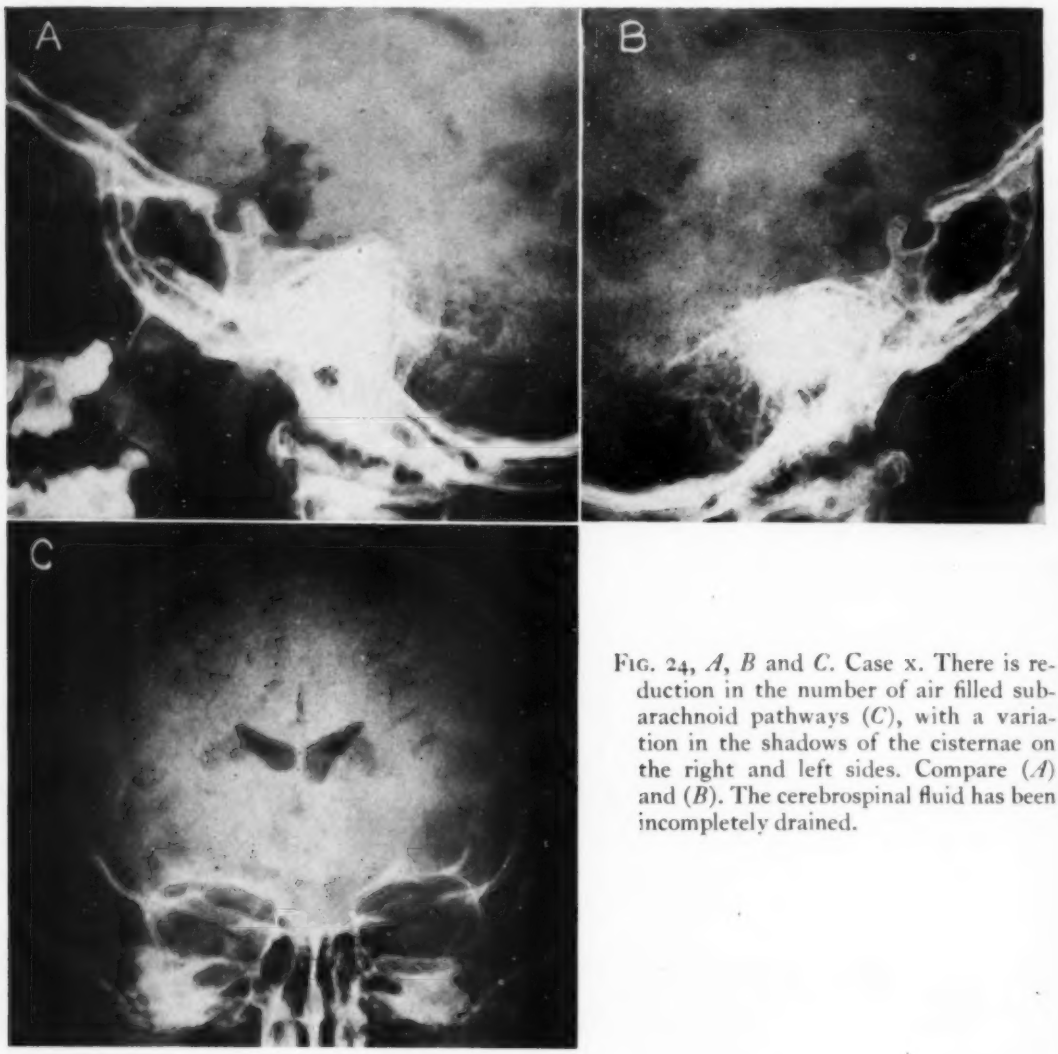

FIG. 24, *A*, *B* and *C*. Case X. There is reduction in the number of air filled subarachnoid pathways (*C*), with a variation in the shadows of the cisternae on the right and left sides. Compare (*A*) and (*B*). The cerebrospinal fluid has been incompletely drained.

lateral ventricles are only partially drained. Note the difference in the appearance of the cisterna interpeduncularis in the right and left sagittal views. A diagnosis of arachnoiditis would not be justified without a more satisfactory study following complete drainage of the spinal fluid. This case and Case IX illustrate the necessity for adequate drainage of spinal fluid during the procedure of encephalography in patients suspected of arachnoiditis.

SUMMARY

Optochiasmatic arachnoiditis is an inflammatory process which produces a syndrome that is similar to that produced by a tumor in the region of the optic chiasm.

Four cases of chiasmatic arachnoiditis, one of luetic origin, are presented. The condition cannot be diagnosed by conventional roentgenograms, but can be by employing pneumo-encephalography.

The normal cisternae in the region of the optic chiasm and some of the structures within and adjacent to them are described.

The encephalographic findings in optochiasmatic arachnoiditis are rather typical in some instances, in others suggestive.

These include shadow patterns of adhesions, cysts or complete obliteration of the air shadows of the basal cisternae in the region of the optic chiasm.

Pitfalls in diagnosis are discussed and illustrated. These include errors in technique such as incomplete drainage and examinations in the horizontal posture employing a vertical beam.

Lesions such as a tumor in the region of the optic chiasm are shown to illustrate the difficulty of differential diagnosis in some instances.

This condition can be diagnosed in most instances by the roentgenologist with the aid of pneumo-encephalograms if optochiasmatic arachnoiditis is suspected.

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Vol. 56, No. 3

SOME OBSERVATIONS CONCERNING THE HYPOPHYSIAL FOSSA*

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INTRODUCTION

IN 1886 Pierre Marie described a syndrome which he called acromegaly. A year later Minkowski suggested that this syndrome might be caused by a lesion of the pituitary body. In 1898 Oppenheim recognized that intracranial disease might be reflected in roentgenograms of the skull. He was the first to diagnose a pituitary adenoma by roentgen study. In 1902 Fuchs and Holtzknecht, without prior knowledge of Oppenheim's study, reported a similar case in which there was widening and deepening of the pituitary fossa due to tumor. In 1909 Gramegna treated the first case of pituitary tumor with temporary improvement of the patient's symptoms (acromegaly). Between 1909 and 1914 Béclère reported several cases of this disease which were improved by roentgen therapy. He states that anterior lobe tumors of the hypophysis were the only intracranial neoformations which one could say with certainty would be improved by roentgen therapy[29] In 1922 Schüller gave credit to Erdheim for teaching the differentiation between sellar changes resulting from adenoma and those due to extrasellar tumors. In 1915 Kupferle and von Szily described the advantages of postoperative roentgen therapy. The date of the first surgical exploration was February, 1902.[8] The above historical facts have been obtained from the relatively recent writings of Pancoast,[25] Pohle[29] Dyke and Davidoff,[11] and others.

It should be recalled that prior to 1926 surgical access to the gland was by the trans-sphenoidal route. Following 1926, however, the approach of choice has been right frontal craniotomy (transfrontal route). At the present time there are two schools of thought regarding therapy: (1) those who favor postoperative irradiation, and (2) those who feel that post-irradiation surgery is often the most acceptable procedure.

Mayfield[21] believes that surgery is often facilitated by prior deep therapy, the tumors thus being more sharply demarcated and, therefore, more readily enucleable. In favor of surgery is the rapid decompression of the brain, the relief of tension on the optic chiasm, and the advantages of surgical biopsy. Against immediate operation is a relatively high mortality rate ranging between 10 and 20 per cent in some clinics.[16] In this connection it is interesting to speculate upon the decongestive effect which roentgen therapy must have on highly vascular adenomas such as one recently encountered in this hospital. Attention is also directed to the value of irradiation in cases where very little optic reserve remains; in other words, in those patients whose visual fields show evidence of extensive damage with only small residual seeing areas present. Operation in such instances, due to edema and other factors not clearly understood, may result in total loss of vision. Cautious roentgen therapy in such cases would appear to be the preferable method. Pfahler and Spackman[28] state that cystic changes occur in 20 per cent of adenomas while 80 per cent are solid. The latter are, in the broad sense, the only tumors which can be considered radiosensitive, although there is still appreciable individual variation. It is not within the scope of this paper to consider the therapy of pituitary tumors in detail, however. The above facts will serve to indicate that each case must be individualized and an impartial course followed. Marked preference for either irradiation or surgery alone is unlikely to result in optimum benefit to the patient.

* From Percy Jones General and Convalescent Hospital, Battle Creek, Mich.

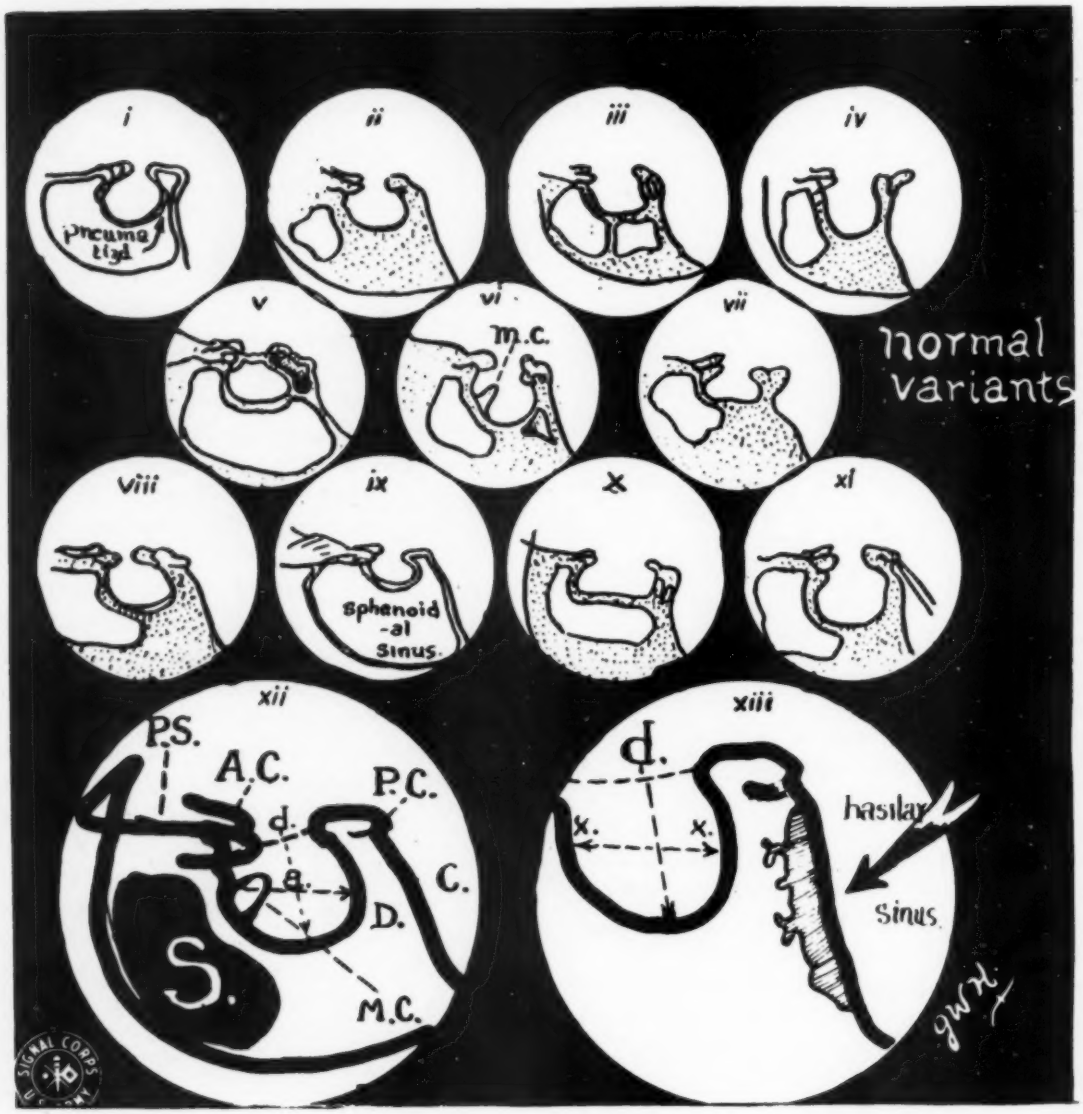


FIG. 1. *i*, extensive pneumatization of the dorsum. *ii*, hook-bill type of dorsum with oval contour. *iii*, partial pneumatization of the dorsum sellae. *iv*, marked prominence of the posterior clinoid processes. *v*, partial pneumatization of the dorsum with bridging between the anterior and posterior clinoids. *vi*, middle clinoid is well developed at *m.c. vii*, oblong type of sella turcica with bulbous dorsum and pointed anterior clinoids directed superiorly. *viii*, hooked or beaked type of sella turcica. *ix*, extensive pneumatization of the dorsum sellae with small hypophysial fossa. *x*, flat type of pituitary fossa. *xi*, circular type of pituitary fossa with evidence of physiological calcification in the petroclinoid ligaments. *xii*, *P.S.* is the planum sphenoidale. Anterior clinoids at *A.C.* Posterior clinoids at *P.C.* Clivus at *C.* Dorsum at *D.* Middle clinoid at *M.C.* Position of diaphragma at *d.* Anteroposterior diameter at *a.* Sphenoidal sinus at *S. xiii*, normal basilar sinus modified from Kornblum. At *d* is shown the normal curvilinear concave sweep of the diaphragma sella from which the vertical dimension is measured. *x*—*x* equals the anteroposterior dimension used in measuring the pituitary fossa. Basilar sinus at arrow.

NORMAL MEASUREMENTS AND VARIANTS

In a recent clinical roentgenological conference held in our hospital* considerable variance of opinion was expressed regarding the normal size of the pituitary fossa of young male adults. Doubt was expressed as to the validity of previously reported pituitary measurements. With this in mind, from a group of 614 skull examinations made during the year ending December 31, 1944, 100 apparently normal cases were selected for study. The pituitary fossas were measured according to the technique of Pendergrass[26] and Kornblum.[19] Their method is graphically illustrated in Figure 1, *xii* and *xiii*. Guided by previous experience in measuring various dimensions of the infant skull[14] calipers were used to determine, as accurately as possible, each diameter under consideration. The various types of sella turcica were also noted and classified. Our results are indicated in Table 1.

TABLE I

Number of cases measured		100
Average anteroposterior diameter		10.66 mm.
Average depth		8.30 mm.
Range	Anteroposterior 13×depth 9 mm.—Largest fossa	
	Anteroposterior 8×depth 5 mm.—Smallest fossa	

These figures agree closely with those reported by Kornblum[19] who found 10×8 mm. the normal average of 1,000 cases measured. His upper limits of normal, anteroposterior 12×depth 10 mm., parallel our own, anteroposterior 13×depth 9 mm. By comparison the average measurement of fossas of 6 patients with chromophobe adenomas encountered during the last year was anteroposterior 23× depth 17 mm. In 1 case of malignant adenoma, however, which is reported in detail below, measurements were found to be somewhat less (anteroposterior 20× depth 10 mm.)

Seven per cent of our cases showed bridging of the sella, comparing favorably with Camp's figure of 5.5 per cent. Bridging is usually between the anterior and posterior clinoids, but in 1 of our cases (Fig. 2) it was between the middle and posterior clinoids. The usual contour was oval, 53 per cent; a round contour was present in 28 per cent while in 19 per cent the sella was either oblong or flat. The average measurements in children are somewhat less than those above. Pendergrass[26] finds that between six to ten years of age the anteroposterior diameter is 7 to 8 mm.×depth 6 to 7 mm.

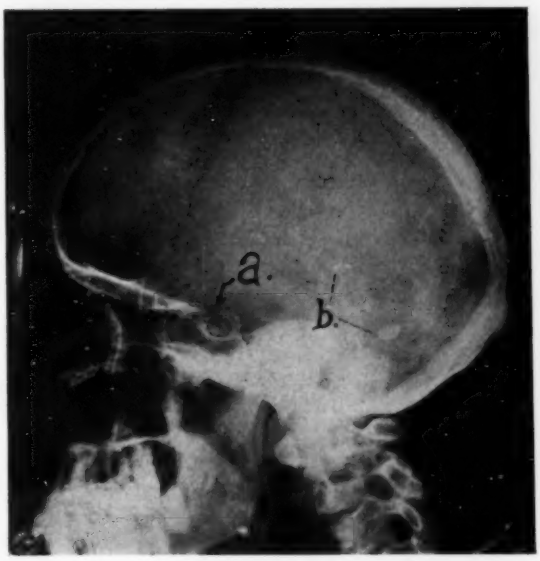


FIG. 2. Unusual bridging of the pituitary fossa, due to ossification between the middle and posterior clinoids on one side.

During our survey numerous interesting normal variants were encountered and are shown in Figure 1. In drawing *iv* is seen an unusual posterior clinoid. In *vi* is shown the appearance of the normal middle clinoid, which often acts as a flying buttress to form the entrance to the caroticoclinoid canal. In from *i–xi* inclusive can be seen the various degrees of pneumatization which one may expect to find in a hundred skull studies. The dorsum sellae is often partially or wholly invaded by the sphenoidal sinus. In addition to the straight-backed sella and the bridged sella, men-

* Percy Jones General and Convalescent Hospital.

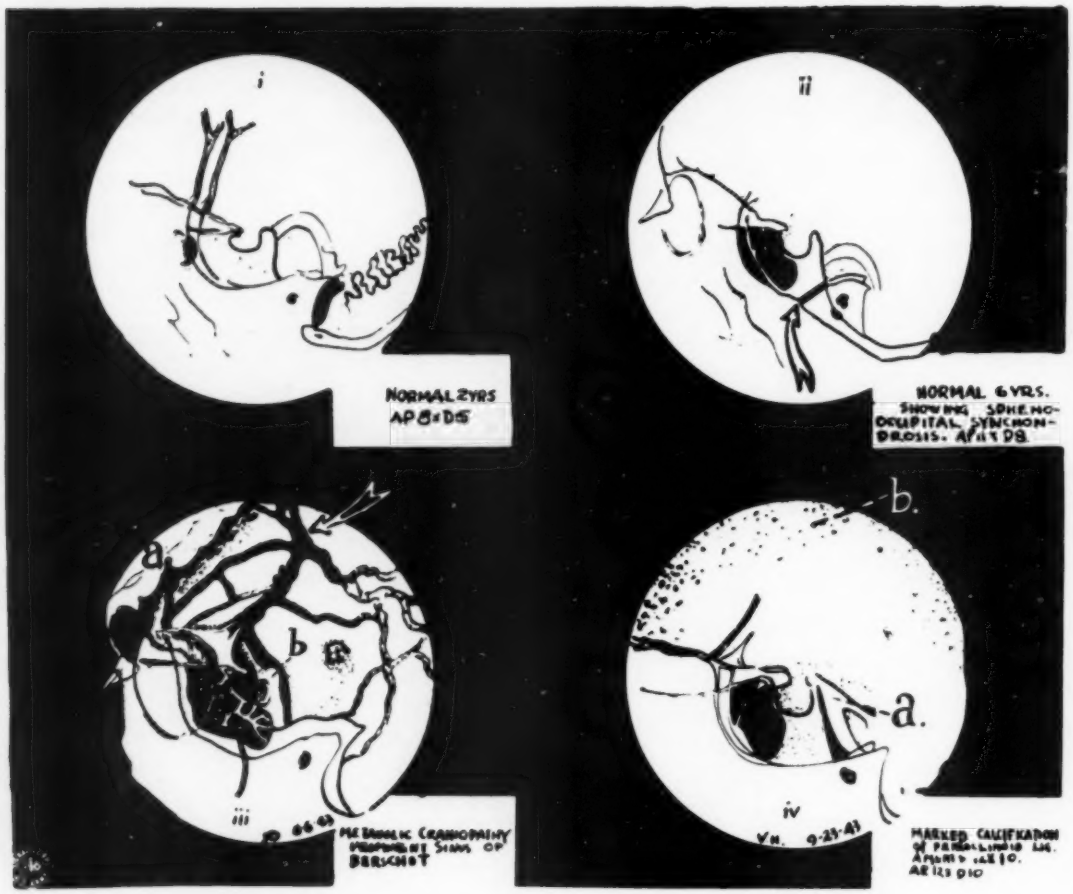


Fig. 3. *i*, normal appearance of sella turcica in child, aged two. Anteroposterior 8 and depth 5 mm. *ii*, normal appearance at six years. Note the normal spheno-occipital synchondrosis. On the roentgenogram this usually disappears between eight and twelve years of age. *iii*, appearance of sphenoparietal sinus of Berschet. Due to the prominence of the sphenoparietal sinus in this individual a diagnosis of meningioma was made elsewhere. The patient's headaches were apparently due to a metabolic craniopathy shown at *a*. The sinus of Berschet is shown at the arrow and continuing down behind the lesser wing of the sphenoid to enter the anterior portion of the cavernous sinus. The dorsum sellae is shown at *b* and appears considerably demineralized. *iv*, marked calcification of the petroclinoid ligaments in patient with von Recklinghausen's disease (parathyroid tumor). Marked porosity of the calvarium is shown at *b*. Calcification of the petroclinoid ligaments is at *a*.

tioned above, two main types of dorsum are encountered, the hooked type (*viii*) and the clubbed shaped type (*vii*) shown in the drawing. In Figure 1, *xiii*, attention is called to a little known sinusoidal system described by Kornblum. The drawing is slightly modified from Kornblum's original illustration. This is the basilar sinus which, according to Batson, lies between the dura and the clivus. It communicates with the cavernous and the inferior petrosal sinuses bilaterally. Pulsation of the brain is said to be transmitted to the basilar sinus in such a manner that demineralization may result.[19] This decalcification must be differentiated from the "senile atrophy" described by Schüller,[30] or the demineralization produced by minute basophilic adenomas. One might expect that a persistent rest of the notochord, the so-called ecchondrosis physalifora[2] would cause a similar appearance.

The roentgenologist must be conversant with numerous normal variants in the im-

mediate vicinity of the sella. Small vessels are not infrequently seen arising from the floor of the middle fossa. These course in an axial direction across the squamosal portion of the temporal bone. In the lateral roentgenogram of the skull these channels may appear superimposed on the hypophysial fossa (Fig. 4, *i*), thus simulating fracture lines. These vascular markings are not dissimilar in appearance to the grooves of the anterior meningeal arteries, the latter arising from the anterior ethmoidals in the frontal region. Only two fractures involving the sella have been encountered during the past year, one of which is illustrated in Figure 7, *i*. The elevation of the cortical bone forming the floor of the fossa, and the sharp demarcation of the fracture line hardly leave doubt as to the diagnosis. So far we have not found a complete fracture of the dorsum due to shearing forces exerted along the petroclinoid ligaments, such as has been described by Pancoast and his associates in their excellent text of neuroroentgenology.[26]

In our experience, the sinus of Berschet, first described in 1831[3] has often been incorrectly considered to be the channel of the middle meningeal artery. This channel, also known as the sphenoparietal sinus, appears to arise from a venous lake near the sagittal suture. Its course, meandering at first, ultimately becomes straight, extending downward just dorsal to the lesser wing of the sphenoid to pierce the sphenoidal dura and enter the cavernous sinus anteriorly. A large sinus of Berschet, recently encountered here, was incorrectly diagnosed elsewhere as evidence of the presence of a meningioma. Time, however, has proved that the patient did not have an intracranial neoplasm. The symptoms were explained satisfactorily on the basis of a metabolic craniopathy (Fig. 3, *iii*).

Calcification of the petroclinoid ligaments is a well known entity. An unusually extensive ossification of these ligaments was recently observed in our department. This patient had a proved parathyroid tumor.[4] It is not unlikely that in this particular instance the hypercalcemia, which amounted to 17 mg. per 100 cc., accounted for the unusual density of these ligamentous structures; an accentuation, as it were, of a normal variant. Marked porosity of the calvarium was present, a kind of "salt and pepper" effect which would likely have led

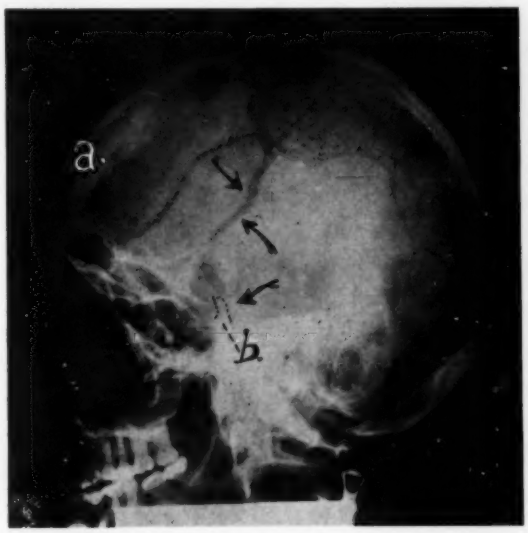


Fig. 3*A*. Illustration showing a large sinus of Berschet in patient with metabolic craniopathy (Sherwood Moore). Hyperostosis frontalis interna is shown at *a*. The markedly demineralized sella is outlined at *b* and sinus of Berschet is indicated by arrows.

to the correct diagnosis even without the aid of long bone studies (Fig. 3, *iv*). A not infrequent normal variant, which may give rise to confusion, is the presence of a small hyperostosis projecting from the internal surface of the squamosal portion of the temporal bone (Fig. 5, *i*). Such a density may simulate a calcific deposit within the hypophysis itself, but its true nature is readily recognized when the roentgenograms are viewed stereoscopically. It should be recalled that calcium deposits may be found within the pituitary gland due to degenerative changes and are not necessarily of clinical importance.[27] Faint calcification above the level of the diaphragma, however, is of great importance and more than likely indicates the presence of a

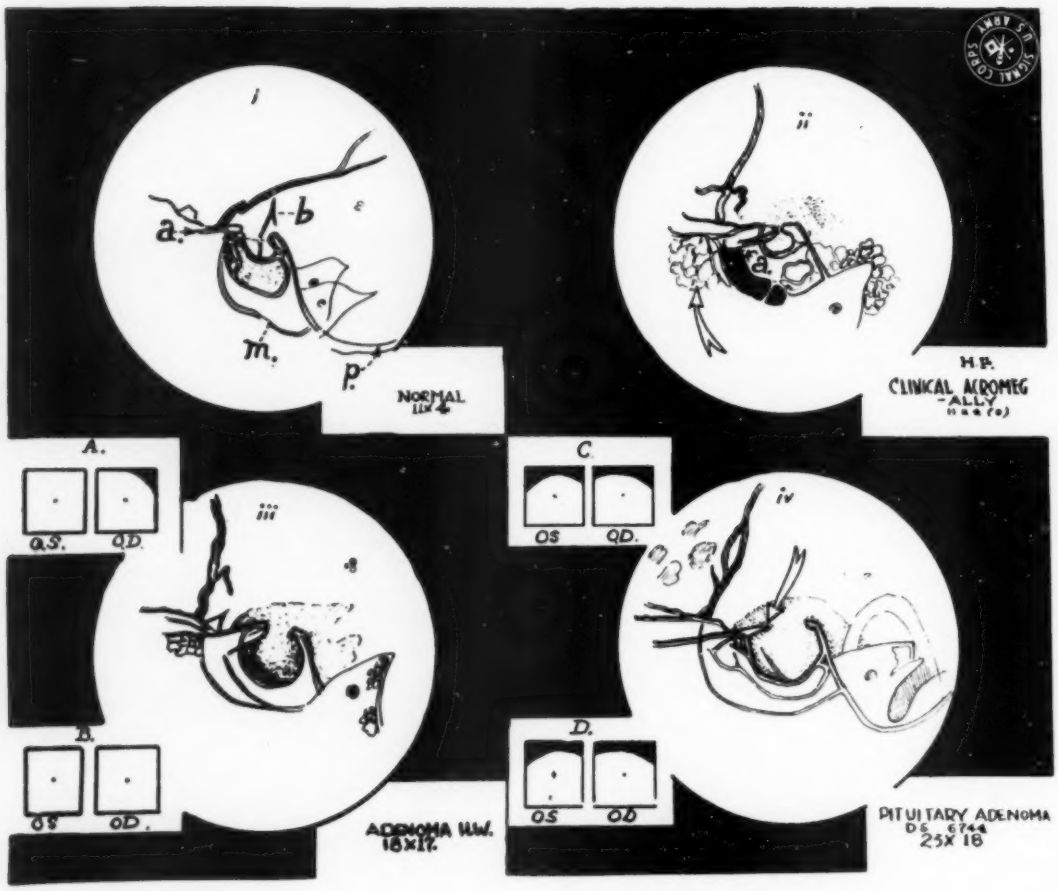


FIG. 4. *i*, upper left hand illustration showing normal anatomical relationships. At *a*, the anterior cranial fossa. At *m*, the middle cranial fossa and at *p* the posterior cranial fossa. Dotted line indicates the approximate site of the diaphragma. At *b* is seen a vascular channel on the internal surface of the squamosal portion of the temporal bone. Vascular lines at this site are often erroneously called fractures. *ii*, right upper illustration shows good example of clinical acromegaly without positive roentgen findings. Fossa measured anteroposterior 11—depth 4 mm. Because of the secondary line noted at *a* one had to consider the possibility of the adenoma decompressing itself into the sphenoidal sinus. Normal ethmoidal cells are shown at arrow. There were no positive visual field findings and libido was normal, basal metabolic rate,—13 per cent. Frontotemporal headaches disappeared following specific therapy for malaria. *iii*, twenty-seven year old Pfc. with history of weakness and anemia since 1937. Occipital headaches following otitis media. At first a diagnosis of psychoneurosis was entertained. Roentgenogram showed evidence of pituitary adenoma with fossa measurements of anteroposterior 18×depth 17 mm. Visual fields prior to therapy are shown at *A*, showing temporal quadrantic contraction on the right. *B* shows appearance following deep roentgen therapy carefully coned to the lesion. Each of three 7×7 fields received 2,000 r (air). There was marked subjective visual improvement, and the visual fields became normal. *iv*, lower right illustration. Pituitary adenoma in twenty-two year old Pfc. with history of fainting spells starting in August, 1942. Increase in size of nose and ears, spade-like hands. Since April, 1944, mild headaches, loss of eyelashes. Following deep roentgen therapy, 2,000 r (air) to each of three 7×7 fields in June and July, 1944, there was marked symptomatic improvement. Recheck of the visual fields showed no progression of the lesion. At *C* is shown the appearance of the visual fields on the tangent screen in June, 1944, with relative altitudinal defects most marked bitemporally. It is felt that roentgen therapy in this case has prevented extension of the lesion.

Rathke's pouch tumor or other pathological change in this vicinity.

OPHTHALMOLOGICAL CONSIDERATIONS

We believe that the majority of roentgenologists are well acquainted with the facts stressed by Cutler and Buschke[10]: "The visual fields must be regularly and carefully checked during and following irradiation and treatment interrupted as soon as noticeable impairment or further damage of the vision is demonstrated." Much credit is due our Ophthalmologic Service for the meticulous attention with which both the visual acuity and the fields of our patients have been followed.

We feel that the following, although well known, is important enough to warrant further repetition. The ophthalmological changes seen with pituitary tumors include visual field alterations, eye-ground changes, ocular palsies and disturbances due to actual invasion of the orbit. Of these, the visual field changes are the most interesting and important. Much of our present understanding of the effect of pituitary tumors on the visual fields and their interpretation is the result of the work of Walker and Cushing,[33] Traquair,[32] de Schweinitz,[31] and other pioneers in the field.

The majority of ophthalmologists use a perimeter at $\frac{1}{3}$ meter and a tangent screen at 1 or 2 meters for visual field determination. The use of colored test objects on the perimeter or small test objects on the tangent screen provides a delicate test which reveals the earliest field changes. Lowered illumination also is an aid in the early diagnosis.

The defects observed are due either to stretching, compression, or invasion by tumor of the chiasm, the optic nerves (anteriorly), or the tracts (posteriorly), these structures being injured as the result of interference with their vascular supply. Compression may be direct, by the tumor, or indirect, by adjoining structures. Grooving of the nerve by the anterior cerebral or anterior communicating artery is an excellent example of the latter.[20] According to Jefferson,[18] in the normal fixation (or usual position) of the chiasm the adenoma must rise at least a minimum of 2 cm. before causing visual symptoms. Usually roentgen evidence precedes visual field involvement. The earliest field defect observed is usually a mild contraction of one or both superior temporal quadrants with colors on the perimeter or small objects on a tangent screen; a so-called relative defect (Fig. 4, *A*). If the case is typical, and allowed to progress, the changes may continue until a bitemporal hemianopsia develops and becomes more and more nearly absolute with the passage of time, one side usually progressing more rapidly than the other. Not infrequently, however, the field change is more bizarre and may take on one of a number of forms representing involvement of one optic nerve, or one tract or a combination of either of these with a chiasmal defect in addition. Among these one sees not infrequently a homonymous defect, usually asymmetrical, at times associated with central visual field involvement, i.e. a central scotoma or blind spot. One may also see unilateral blindness with a defect in the other field or possibly, nasal or temporal hemanopia with or without a defect in the contralateral eye, and so on. The above findings all depend upon whether the area affected is the optic nerve, the optic tract, the chiasm or a combination of these parts.

The ophthalmologist can usually state that the field change indicates the presence of a prechiasmal, chiasmal or postchiasmal tract lesion. By the nature of the defect, by which is meant its relative or absolute quality, its mode of onset and progression, one often, with fair certainty, can differentiate between tumor, vascular lesion and one of inflammatory or degenerative origin. In differentiation one must consider aneurysm, basofrontal tumor of other than pituitary origin as meningioma, Rathke's pouch tumor, or chiasmal arachnoiditis, retrobulbar neuritis, syphilis and other inflammatory lesions. Aneurysm in the region

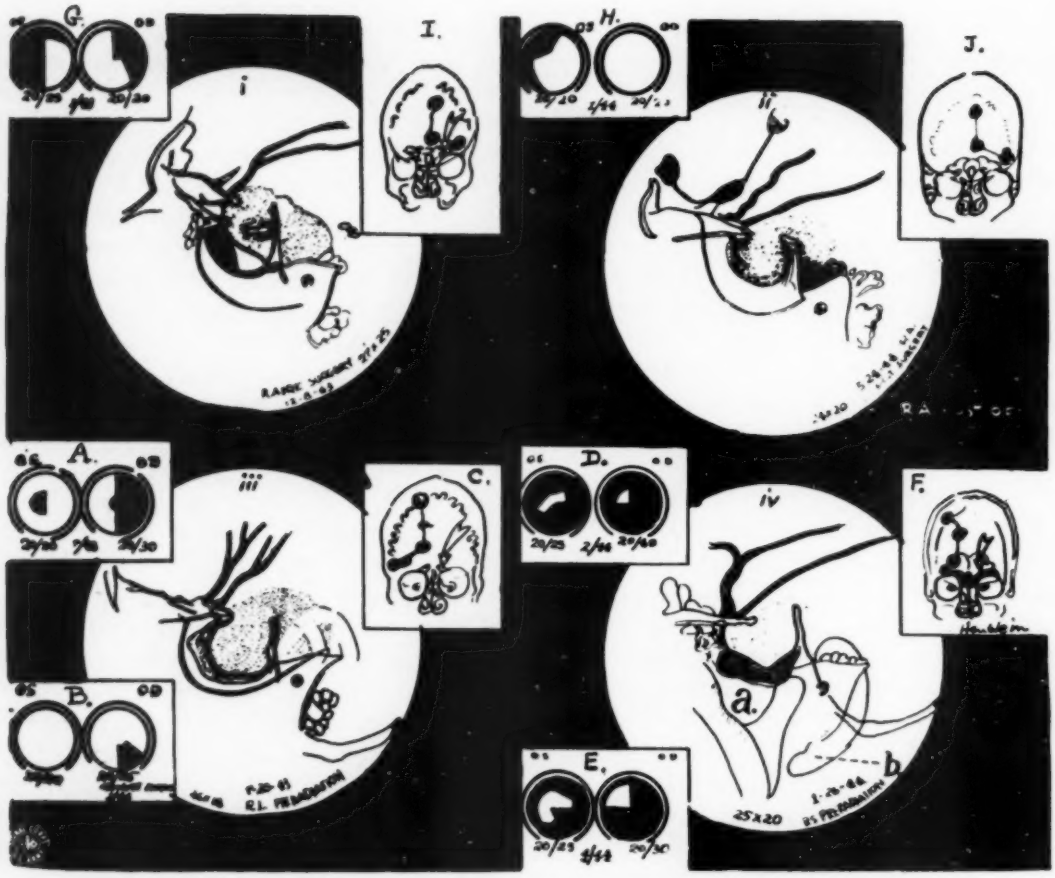


Fig. 5. *i*, left upper illustration shows typical adenoma of the pituitary in a thirty-eight year old officer, with history of blurred vision of the outer half of the left eye since May, 1943, bilateral frontal headaches and difficulty reading fine print. Patient operated on January 21, 1944. A vascular type of adenoma was removed. Postoperative roentgen therapy had to be curtailed because of persistent wound infection. Roentgenogram made four months after surgery (*ii*) shows marked improvement in the appearance of the sella turcica which measures 24×20 mm. compared with previous measurements of anteroposterior 27×depth 25 mm. Improvement in the visual fields due to surgery alone is shown graphically in *G* (preoperative visual fields) and *H* (postoperative visual fields). In *G* is seen a bitemporal hemianopsia which is relative in the right eye. Funduscopic examination showed mild pallor on the right and moderate pallor on the left with loss of substance. Lower left illustration (*iii*), twenty-five year old Pfc. with history of fleeting headaches and failure of lateral vision which was noticed when he was in close-order drill. Note the scalloped appearance of the ventral wall of the dorsum sellae apparently the result of a bilobed tumor. Eye consultation suggested possible ventricular involvement.

Between July 24 and September 23, 1943, he received 2,600 r (air) to each of three fields, cross-firing the lesion. There was marked temporary improvement following therapy, but later vision failed and it was felt that cystic changes might be taking place. A craniotomy was therefore carried out on December 13, 1943, by Lt. Col. Frank H. Mayfield. *A* shows the appearance of visual fields prior to roentgen therapy with, absolute temporal scotoma in the left eye and absolute hemianopsia on the right with a relative central scotoma. Postoperatively full vision was obtained on the left side and on the right there was an absolute inferior quadratic defect which was thought likely to be the result of compression of the chiasm from above by the anterior cerebral artery. Funduscopy showed pallor, mild on the left and pallor, moderate on the right side. *C*, *F*, *I*, and *J* show the appearance of the anterior clinoids in each case.

Lower right illustration (*iv*), pituitary adenoma in patient aged twenty-nine. History of frontal headaches, polyuria and gain of weight starting in October 1942. Twelve months later marked optic atrophy and bitemporal hemianopsia. Patient was operated on fourteen months after onset of symptoms. At operation the optic nerves were found stretched over the tumor capsule. There had been no subjective failure

of the sella, sclerosis of the internal carotid arteries in older people, third ventricle dilatation, all may be suggested by field defects.

When a progressive chiasmal lesion is suggested by field examination and the pituitary fossa is normal by roentgen study, the diagnosis of aneurysm must be considered. This is especially true when craniotomy is contemplated, for success of surgery is often dependent on previous suspicion of and preparation for the management of such a lesion.

Ophthalmoscopic changes occur in the form of primary optic atrophy. Early the discs appear normal, later pallor is noted, and still later loss of substance and secondary generalized retinal arterial narrowing. These latter changes usually indicate permanent damage of some degree. *Choked discs are rarely seen and then only with large tumors where the ventricular system is impinged upon or the foramen of Munro obstructed.*

Partial or complete involvement of the third, fourth and sixth cranial nerve also may occur with lateral extension of the tumor from the sella. Involvement of the sixth nerve is the least common. Third nerve palsy may be complete with ptosis and divergence, or mild, with weakness of only one or two muscles. Rarely, there may be actual invasion of the orbit by tumor.

Interpretation of the visual field findings usually throws some light on the severity of the damage done, the degree of improvement following irradiation and surgery, and offers as well, a delicate means of evaluating the effectiveness of therapy. An excellent example is one of our cases, R. L., whose seller changes are shown in Figure 5, *iii*. Following preoperative roentgen therapy (2,600 r to each of three 7×7 cm. fields), there was marked improvement in the visual fields. By persistently reviewing the fields we were then able to demonstrate a decrease in the seeing areas. This led us to believe the patient might be developing a cyst. Transfrontal craniotomy was carried out by Lt. Col. Frank H. Mayfield. Marked improvement in vision followed with only a small residual absolute defect demonstrable in the right field. This is shown graphically in Figure 5, *B*. Cusick[9] has directed our attention to the fact that if marked damage has already occurred with only small remnants of the fields remaining even more consideration must be given to the choice of treatment, i. e. whether to use deep roentgen therapy or surgery, for sudden alteration in the physiology or transient edema of the optic nerve or chiasm may lead to further damage. This effect might be compared to the sudden blindness following decompression of the eyeball

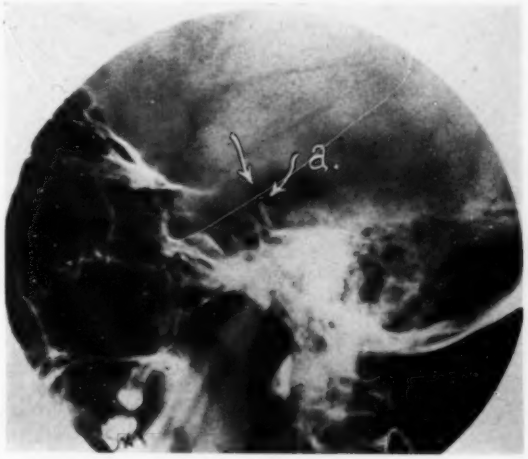


Fig. 6. Characteristic appearance of the hypophysial fossa in patient with pituitary adenoma (same case as Fig. 5, *iv*). The thinned and apparently elongated dorsum sellae is shown at *a*.

of vision, but marked constriction of the right visual field and moderate constriction of the left as shown in *D*. The patient received in February and March, 1944, 1,700 r (air) to each of three fields, cross-firing the hypophysial fossa, with the resultant improvement shown in *E*. *E* shows a concentric inferior and altitudinal contraction, left. Temporal hemianopsia, inferior nasal quadrantopsia and concentric contraction, right. Funduscopic examination shows pallor severe, right disc, with loss of substance. Moderate pallor on the left. Mild secondary narrowing of the retinal arterioles.

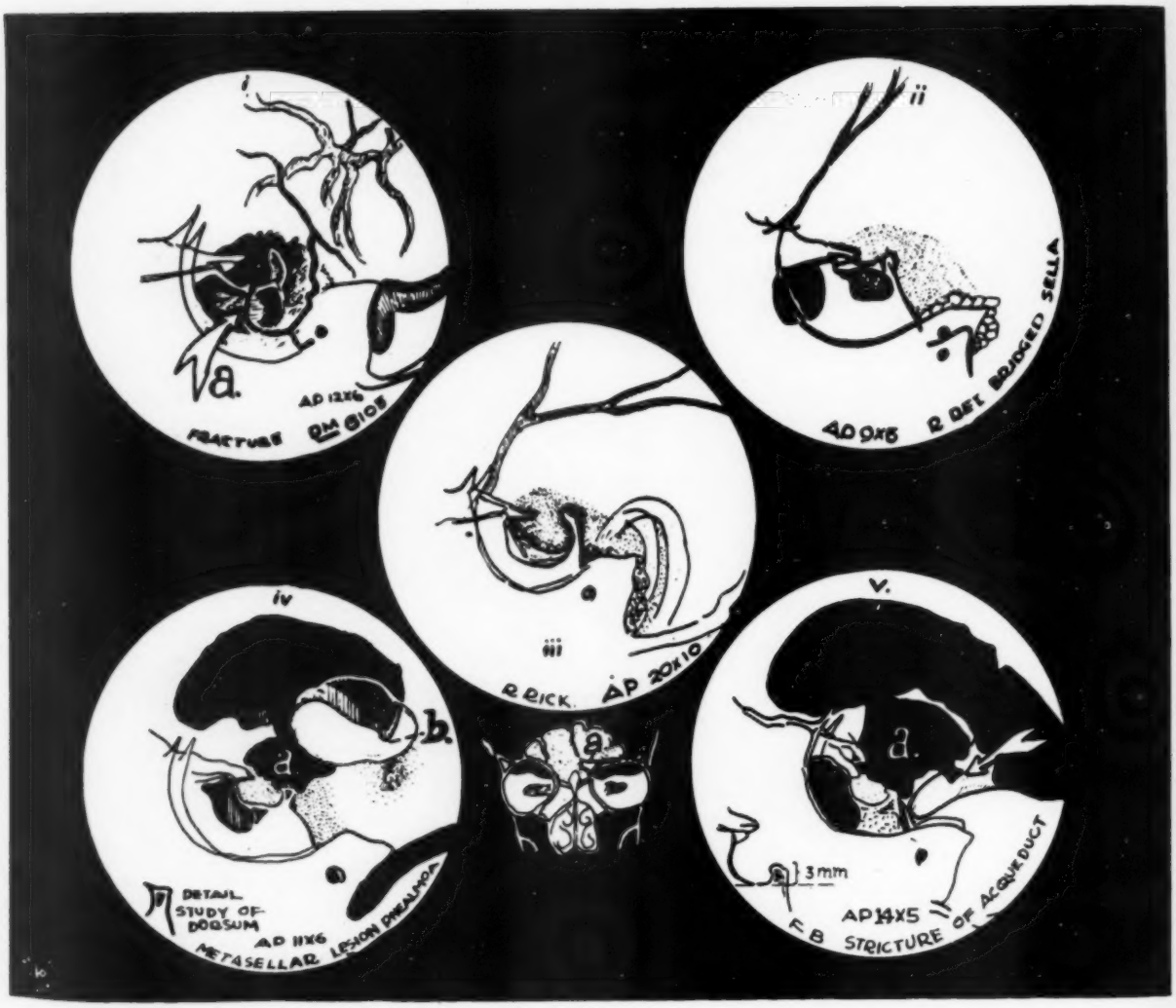


FIG. 7. *i*, left upper illustration shows fracture involving the middle cranial fossa and floor of the pituitary fossa, at *a*. This soldier was severely injured in an automobile accident while on authorized pass. After he recovered consciousness the fracture shown above was demonstrated. He had involvement of the right fifth, sixth and seventh cranial nerves with incomplete recovery which necessitated tendon transplant to the insertion of the external rectus muscle in order to allow for external rotation of the globe. Right upper illustration (*ii*) shows a normal bridged sella measuring 9×5 mm. for comparison with abnormal hypophysial fossas as shown below (*iii*). Middle illustration shows appearance of hypophysial fossa of patient with malignant adenoma of the pituitary gland. Note the double contoured floor. Fossa measured antero-posterior 20×depth 10 mm. Insert below the illustration shows normal left anterior clinoid at *a*. The right anterior clinoid was missing. Left lower illustration (*iv*) shows appearance of the hypophysial fossa in patient with large pinealoma. The dorsum sellae is eroded from above and its superior margin is relatively concave and sharpened anteriorly. Large pinealoma shown at *b*. Third ventricle shown at *a*. Right lower illustration (*v*)—similar appearance due to an extrasellar lesion caused by stricture of the aqueduct. The third ventricle is shown at *a*. The upper end of the stricture is shown at arrow. Note that the vertical dimension of the dorsum sellae is only 3 mm.

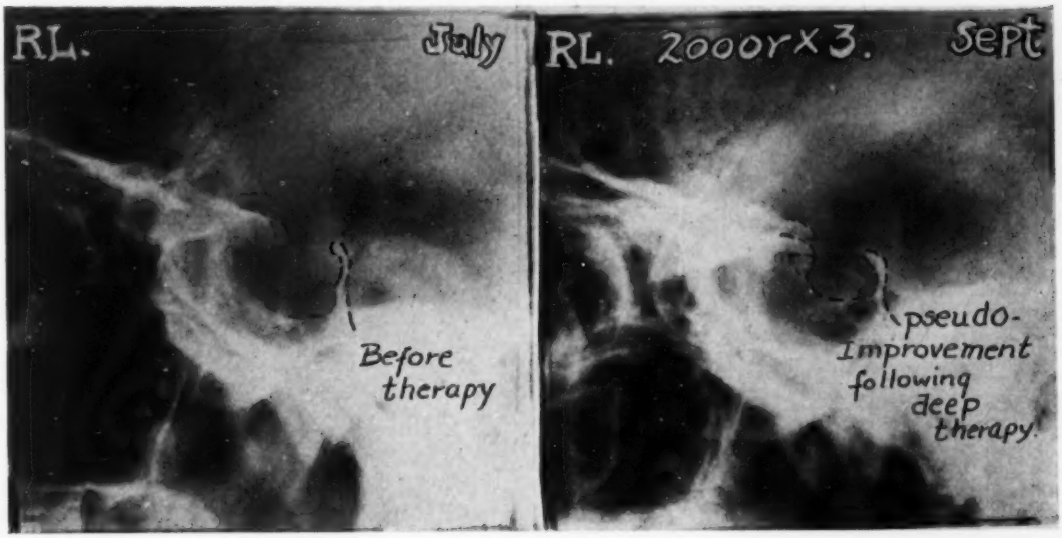


Fig. 8. Effect due to slight differences in the technique employed. Illustration on left shows the appearance of the pituitary fossa before therapy. Right hand illustration shows pseudo-improvement following deep roentgen therapy amounting to 2,000 r (air) to each of three 7×7 fields, cross firing the pituitary fossa. Additional roentgenograms made at a later date show the improvement was not real, but only apparent.

when the optic nerve has suffered previous severe damage from glaucoma.

The changes produced on the visual field by irradiation, surgery, or a combination of both, are often dramatic and especially gratifying in view of the fact that visual symptoms are often the principal reason for treatment.

CHANGES IN THE PITUITARY FOSSA RESULTING FROM ADENOMA

During the years 1943–1944 six cases of pituitary adenoma were treated in the Percy Jones General and Convalescent Hospital, Roentgen Therapy Department. As indicated heretofore, pituitary measurements showed the fossas grossly enlarged, the average size being anteroposterior 23×depth 17 mm. In only 1 instance was the pituitary fossa slightly smaller (20×10 mm.). In the latter we suspected from the roentgen evidence that we were dealing with an intra- as well as an extrasellar lesion. This diagnosis was confirmed subsequently at necropsy.

Changes affecting the pituitary fossa as the result of various diseases are shown in Table II—slightly modified from Kornblum.[19]

The characteristic roentgenographic findings of hypophysial adenoma are well known, but certain diagnostic features are worth re-emphasis.

1. Uniform and general enlargement of fossa with ballooned appearance.
2. Ventral wall of dorsum smoothly eroded, or even scalloped in outline suggesting the presence of a bilobed tumor (Fig. 5, *iii*).
3. Dorsum often displaced posteriorly and apparently elongated, as result of actual deepening of the fossa (Fig. 6).
4. If eccentric in position, adenoma may cause erosion of the ipsolateral anterior clinoid (Fig. 7, *iii*).

Table II

I. Intrasellar lesions, such as pituitary adenomas.
II. Extrasellar lesions.
   a. Suprasellar, as by a Rathke's pouch tumor, or olfactory groove meningioma.
   b. Parasellar, as by an aneurysm of the circle of Willis, or laterally placed neoplasm.
   c. Metasellar lesion, as by a small or large tumor obstructing the aqueduct and causing hypo-

physial erosion by an enlarged and pulsating third ventricle.

III. Changes due to sphenoidal sinus disease.

IV. Changes due to other conditions such as:

a. Metastatic malignancy, multiple myeloma (Fig. 13).

b. Chordoma, xanthomatosis, etc.

Camp considers the above a rare occurrence, but both anterior clinoids should be inspected with care. Attention has also been directed to the fact that once the dorsum has become demineralized, due to pressure changes, normal restoration of calcium salts cannot be expected. Dyke's case, S. F., a female, aged thirty-nine, demonstrates that recalcification can and does take place. Such reossification may be relatively permanent over a period of years. It should be recalled that reconstruction of the sella not infrequently occurs following deep roentgen therapy of nasopharyngioma.[23,24]

Close attention to roentgen technique is imperative, otherwise effects are seen which may cause confusion in diagnosis. This is demonstrated in Figure 8. Following 2,000 r (measured in air) to each of three 7×7 cm. fields improvement in the configuration of the hypophysial fossa was observed. Further serial roentgenograms, however, indicated that the improvement was not real, but resulted from slight differences in the projection of the central ray. In this regard it is worth remembering that lateral stereoscopic roentgenograms should be made of each side in order to obtain a maximum of information. This is particularly true when the possibility of a parasellar lesion is being considered.

In the condition known as acromegaly three types of sellar changes are described:[26]

1. No fossa enlargement or minimal enlargement, but possibly with increased bone condensation changes in the calvarium.

2. Typical ballooned appearance, but showing dorsum often thicker and denser than normal.

3. Extensive destruction as the result of an advanced or malignant type of acidophilic adenoma. This type is differentiated from extrasellar lesions with difficulty.

Additional roentgen findings in support of the above diagnosis are:

1. Prominence of the supraorbital ridges.

2. Hyperpneumatization of the paranasal sinuses.

3. Hypertrophy of the mandible with malocclusion of the jaws and wide spacing of the teeth.

4. Tufting of the ungual tuberosities (distal phalanges).

Regarding changes in the hands, Holt and Hodges[17] state: "the roentgenographic appearance of the hands in acromegaly is so characteristic that the presence of a pituitary eosinophilic adenoma may be suspected even in the absence of intrasellar erosion. Large broad spade-like hands with overgrowth of the terminal phalangeal tufts, prominence of bony protuberances along the shafts of metacarpals and phalanges and a peculiar soap-bubble pattern of distorted trabeculae in the bone ends comprise the changes commonly encountered."

Parasellar lesions are relatively infrequent and often diagnosed with difficulty. Such a lesion may be suspected by a double-contoured sellar floor. In order to exclude improper technique causing this appearance, the anterior clinoids should be superimposed. Moreover, even in the normal skull the two sides are not necessarily absolutely identical, so that careful correlation of all clinical facts is advisable. Any bizarre appearance of the hypophysial fossa, or a roentgen picture not consistent with diagnosis of adenoma should bring to mind some form of extrasellar lesion, either in the para- or metasellar position. Recently a curious appearance of the hypophysial fossa with double floor, ipsolateral clinoid erosion, and demineralization of the dorsum out of proportion to the size of the sella, led us to suggest a combined intra- and extrasellar tumor (Fig. 7, *iii*, and 9). The history follows:

A soldier, aged thirty-seven, was admitted to Percy Jones General and Convalescent Hospital in November, 1944, complaining of blurred

vision of thirteen months' duration. For two months he had been unable to read news type. The patient recalled five changes of glasses by five different physicians since December, 1943. Recently he had noted intermittent severe frontal morning headaches and inability to see people approaching from his left. In July, 1944, he was admitted to a hospital where diagnosis of a pituitary tumor was made. He was referred to our hospital for deep roentgen therapy.

Physical examination revealed an obese soldier, 5′8″ tall; visual field examination showed an absolute left homonymous hemianopsia with concentric contraction and right central scotoma; ophthalmoscopic examination revealed pallor, grade 1—temporally, both discs. Diagnosis: Field change due to a combined chiasmal and tract lesion on the right side.

Roentgen examination revealed an enlarged fossa with a hazy double floor and demineralized dorsum. The sella was not characteristically ballooned. It suggested possible extrinsic pressure by a meta- or parasellar lesion (Fig. 7, *iii*). There was no evidence of increased intracranial pressure. Roentgen conclusions were as follows: "Enlargement of the pituitary fossa plus demineralization of the dorsum sellae. The changes found suggest a parasellar rather than an intrasellar lesion. However, as has been noted by Kornblum, occasionally a pituitary tumor will rupture to the exterior and cause changes suggesting a parasellar erosion."

In this case carcinoma and chordoma, though less likely, could not be entirely excluded. Because of the visual field findings, operative exploration was performed through a right temporal bone flap, by Lt. Colonel Frank H. Mayfield. "The dura was incised along the sphenoidal ridge which brought into view the chiasmal area. There was a purplish tumor mass protruding to the right of the right optic nerve, compressing it, and displacing the right internal carotid artery lateralward. There was an additional extension of this purplish mass projecting upward between the anterior fork of the chiasm. The posterior portion of the chiasm was not exposed at this time. The tumor obviously contained fluid and considerable difficulty was encountered determining whether or not this was an aneurysm or cystic neoplasm. By aspiration, it was proved to contain in certain areas brownish cystic fluid, and so removal was begun. That portion lateral to the right optic nerve was excised uneventfully. The capsule of the tumor between the optic nerves was then excised and removal begun with pituitary curet. Approximately three scoopsful had been removed when a massive hemorrhage occurred from the perisellar area. It was believed that either the internal carotid artery on the left or an aneurysm of circle of Willis had ruptured. Immediately the brain swelled so that exposure was no longer possible; however, it was possible to control the hemorrhage by applying pressure with the index finger to the left lateral portion of the sella, and with difficulty a large piece of fibrin foam, immersed in thrombin, was applied in this region and held for fifteen to twenty minutes, after which it was possible to remove the finger without additional visible bleeding. The brain was extremely tense and the inferior portion of the frontal pole was lacerated considerably in an endeavor to obtain exposure after hemorrhage ensued. Amputation of the frontal lobe was contemplated, but inasmuch as the bleeding was controlled, it was not considered that the patient's condition would be improved by re-exploration of the field." No further procedure was deemed advisable and the incision was closed as rapidly as possible. Despite supportive treatment consciousness was never regained. The temperature rose to 107° F., the pulse to 160, respiration became labored and death occurred twenty-four hours later.

Necropsy was performed by Major S. E. Moolten and the following is a short abstract of the anatomical diagnosis rendered:

1. Invasive chromophobe adenoma (malignant chromophobe adenoma) of anterior lobe of pituitary (Fig. 9*A* and 9*B*).

2. Pressure necrosis of anterolateral branch of left middle cerebral artery, secondary to 1.

3. Massive arterial hemorrhage, subarachnoid, secondary to 2.

4. Extensive erosion and atrophy of right anterior clinoid process.

5. Compression atrophy of both lobes of the pituitary as well as the optic nerves and optic tracts (Fig. 9*C*).

In the genitourinary system were found congenital cysts of the kidneys, a medullary fibroma of the left kidney and fetal lobulation. A chondroepithelial hamartoma (congenital dislocation tumor) was found in the thyroid.

Moolten's discussion of the above findings is pertinent. His comment is presented here in detail:

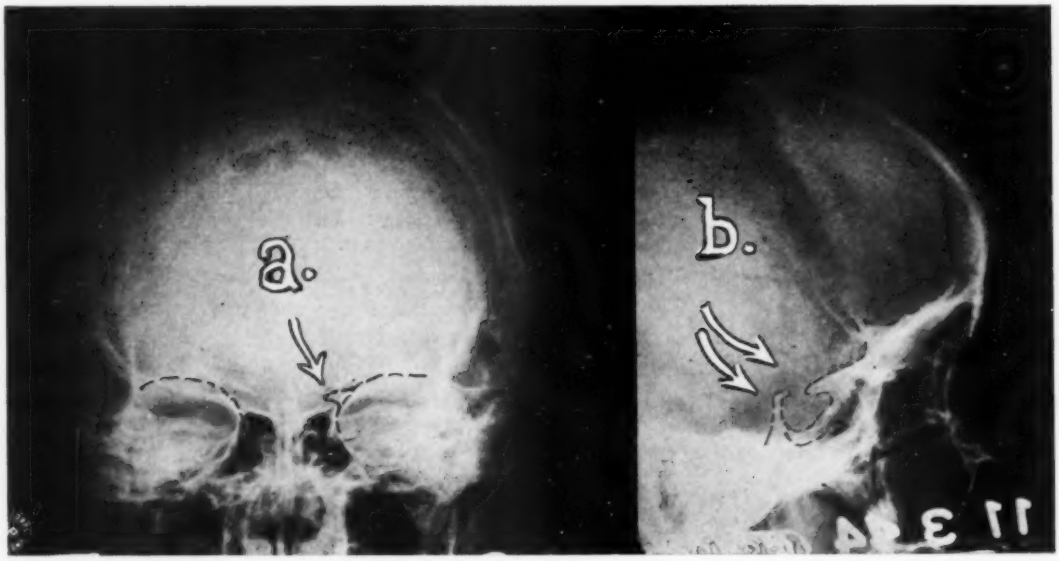
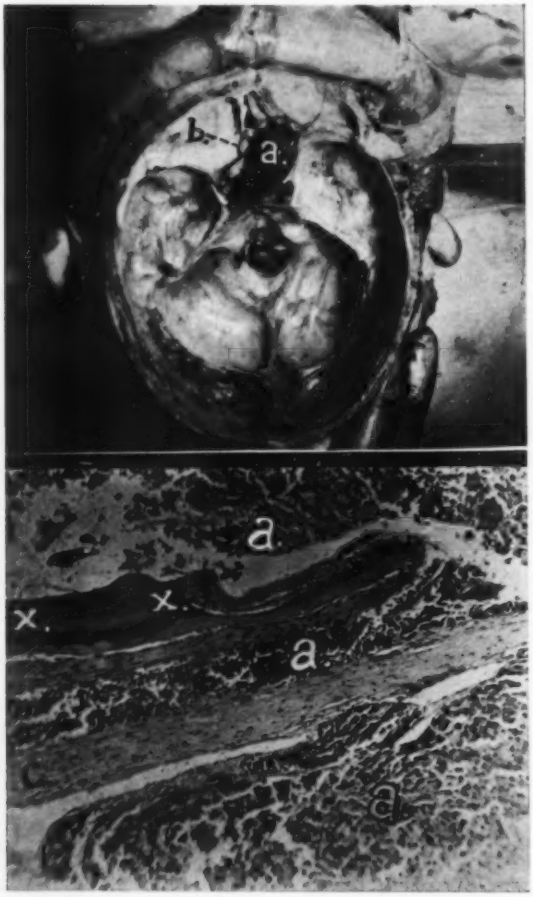


Fig. 9. Illustration showing normal left anterior clinoid at *a* and peculiar configuration of the sella turcica at *b* with double contoured floor (see Fig. 7, *iii*).



The association of a pituitary adenoma with benign tumors of other organs in this same case may not be entirely fortuitous. The medullary fibroma of the kidney is the classical example of hamartoma, i.e., congenital malformation or tissue combination and is probably the paradign of most benign tumors. In the same category, the congenital cyst of the kidneys and the hyalinized cavernoma of the liver may be included, and, in all likelihood, also the leiomyoma of the cardiac end of the stomach. All these manifestations of tissue malformation may be part of a disseminated hamartial tendency which, although of minor degree, may nevertheless be underlying to the development of the pituitary adenoma (cf. frequent association of chromaffinoma and multiple neurofibromatosis).[15,22]

The rapid growth of the pituitary tumor, its extensive invasion of surrounding bone and other tissues, its marked vascularity, and its highly cellular composition are features which are somewhat unusual, in ordinary chromophobe adenoma. For these reasons the diagnosis suggested is malignant adenoma of the chromophobe cells which, as summarized by Bailey and Cutler[1] "differed clinically

Fig. 9*A*. View of the internal aspect of the cranium showing large pituitary tumor in situ at *a* lying slightly to the right of the midline. Compressed left optic nerve is shown at *b*. One can readily see from this illustration why the right anterior clinoid was eroded. Photomicrograph below shows cells of malignant adenoma at *a* causing erosion of bony trabecula at *x*. Dura is shown at *c*.

from the usual case of benign chromophobe adenoma in the history of rapid progression of symptoms, and and in the rapid extension of the tumor into the skull bones adjacent to the sella turcica, the neighboring brain substance and the nasopharynx. . . . Histologically the tumors were characterized by arrangement of the tumor cells in broad sheets separated from one another by a stroma which is altered in character from that of the normal pars anterior and was in part derived from structures at the edge of the tumor, far from the sella turcica, . . . The term 'malignant chromophobe adenoma" indicates that they are locally invasive and possess certain of the histologic characteristics of malignant tumors, but do not metastasize either in the cerebrospinal axis or elsewhere in the body. . . . The tendency of the malignant chromophobe adenoma to include large blood vessels in the sellar region makes surgical approach to it especially perilous!"

In metahypophysial (metasellar) lesions Pendergrass states: "It is not always possible to distinguish with any degree of certainty, between sellar deformity of intra- and extrahypophysial erosion. To make a diagnosis requires careful consideration of

Fig. 9*B*. This is a detailed illustration of pituitary tumor shown in Figure 9*A*. The major portion of the malignant adenoma is shown at *a*. The forward extension of the tumor is seen at *b*. The right and left optic tracts are considerably distorted and are shown at *c–c*, and the right and left optic nerves are well shown, *O.D.* and *O.S.*

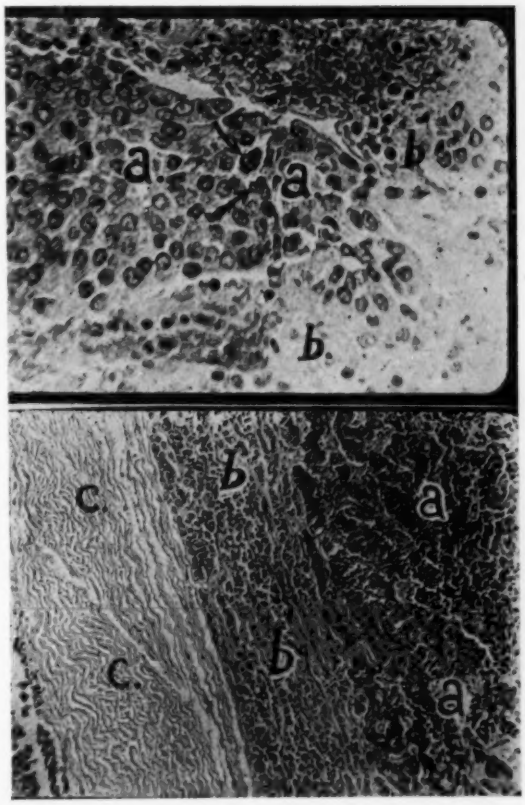


Fig. 9*C*. Photomicrograph showing appearance of neoplasm under high and low power. In the upper illustration a nest of tumor cells is shown at *a–a*, and hyperchromatic nuclei are indicated by arrows. The dura at *b–b* is being invaded. The lower illustration shows malignant adenoma at *a* compressing normal pituitary cells at *b*. Normal dura is seen at *c*.

all findings and sometimes cerebral pneumography in addition."[26] The correct diagnosis is often suggested, however, when the dorsum becomes ragged and thin and appears eroded from above. Camp,[6] in 1924, showed that the pressure of the third ventricle from above produces widening and flattening of the sella. He states: "Since the pressure is transmitted solely from above, the posterior clinoids are eroded from above rather than anteriorly and they become shortened and pointed rather than narrowed and thinned." In Figure 7, *iv* and *v*, are shown two good examples of transmitted pressure. The first is a twenty-nine year old nurse[5] who complained of

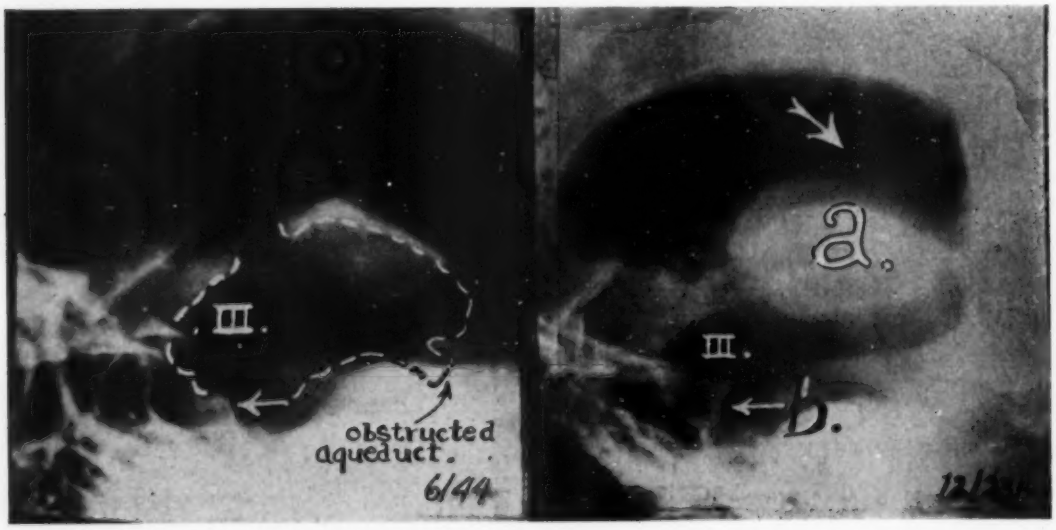


Fig. 10. Ventriculograms showing erosion of the dorsum from above by an enlarged third ventricle. The left illustration shows a huge dilatation of the third ventricle due to fibrous stenosis of the aqueduct and nodular ependymitis. The right hand illustration shows dilatation of the third ventricle as result of large pinealoma at *a*. The erosion of the dorsum is well shown at *b*. This film was obtained with the aid of the cassette supporting arm devised by Bell,[4] and is an example of the type of film routinely obtained with this apparatus

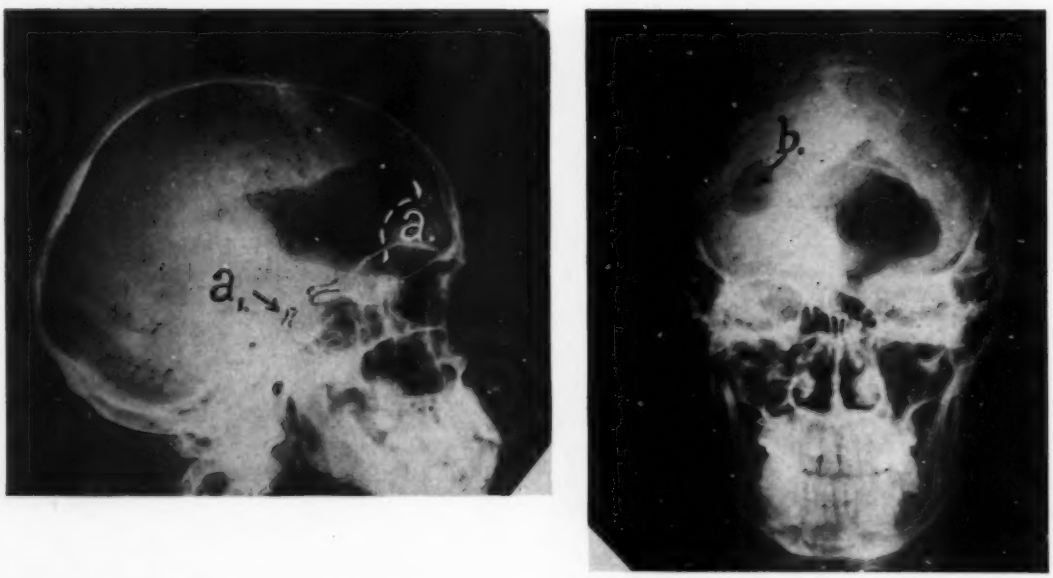


Fig. 11. Illustration shows a large cystic astrocytoma in the left frontal region beautifully outlined by injected air. The mural nodule is shown at *a*. The cyst is self evident. The right lateral ventricle is shown at *b* and is markedly displaced to the right. The dorsum of the hypophysial fossa is demineralized. The anterior clinoids are normal. History: Severe intermittent right frontal headaches, blurred vision, and projectile vomiting. Tumor Board decided against therapy as mural nodule had been completely removed.

severe occipital headache and vomiting of two months' duration. Air study showed marked hydrocephalus from a large oval pinealoma (at *b*). The second case (Fig. 7, *v* and 10) shows a stricture of the aqueduct in a twenty-two year old patient. This patient, a possible angle tumor suspect, had onset of symptoms three years before admission with "blind staggers" and dizziness. Physical examination showed bilateral diplopia and diminished sensation of the left half of the body. Necropsy performed on January 26, 1944, showed severe internal hydrocephalus, secondary to stenosis of the iter plus a granular ependymitis. Roentgenograms of the hypophysial fossa of both patients show marked shortening of the dorsum as compared with the vertical dimension of the anterior fossa wall, and in the first instance there was a definite cupping of the upper or superior margin of dorsum as shown in the detail study (Fig. 7, *iv*). A third case, a large frontal cystic astrocytoma, produced no erosion or thinning of the anterior clinoids as might be suspected, but caused a high degree block of the iter with erosion of the dorsum from the posterior aspect, presumably as the result of posterior displacement of the third ventricle with kinking of the aqueduct (Fig. 11).

An example of a lesion which will occasionally cause destruction of the sella turcica is shown in Figure 12. In this instance a destructive lesion due to a nasopharyngioma, also known as a lymphoepithelioma, was found in the floor of the middle fossa in the left parasellar region. The dorsum sellae, however, was intact. The changes described could only be shown by making stereoscopic roentgenograms in the Bowen-Hirtz or submentovertex projection. A brief history follows:

A colored private, aged twenty, was admitted

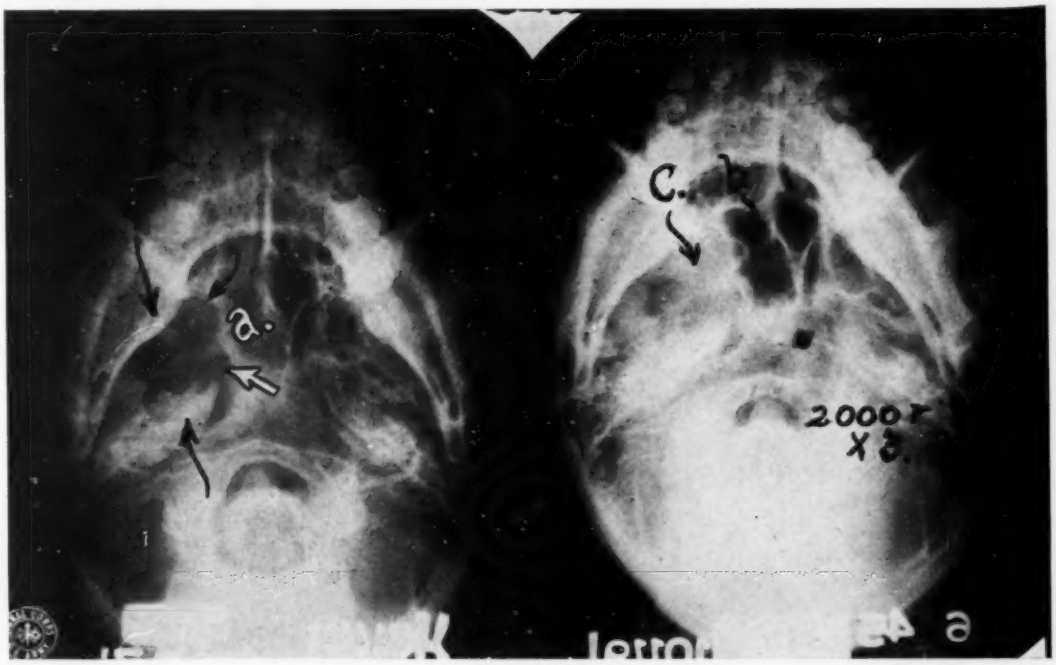


Fig. 12. Case of nasopharyngioma showing, on the left, a large destructive lesion at the base of the skull near the pituitary fossa. The left sphenoidal sinus is shown at *a* and is hazy due to the infiltration by new growth. Following heavy roentgen therapy partial healing of the lesion is seen at *c* and complete clearing of the left sphenoidal sinus is shown at *b*. This improvement followed 2,000 r (air) cross fired into the lesion through each of three separate fields.

to Percy Jones General and Convalescent Hospital Therapy Department with a history of pain in the left facial region of eleven weeks' duration. No history of tinnitis or nasal obstruction was elicited. On examination made at another hospital a mass had been found beneath the angle of the left mandible, and biopsied. Diagnosis of reticulum cell sarcoma was made and subsequently confirmed by the Army Medical Museum. When first seen, the patient complained of severe distress in the region of a well healed biopsy scar, but no significant lymphadenopathy was palpable in the left cervical region. The patient complained of severe lancinating pain in the left retroorbital region. Roentgenograms showed widespread infiltration of the middle cranial fossa indicated at *a*, Figure 12. The roentgen picture was characteristic of metastatic nasopharyngioma. Provisional diagnosis was confirmed by the Nose and Throat Section after nasoscopic examination by Lt. Colonel C. W. Barkhorn. A mass was palpable behind the posterior pillar of the left tonsil. This extended upwards to the eustachian tube orifice. Edema and swelling were encountered by the examining finger and were also seen on postnasal mirror examination. The patient was found to have a conduction deafness on the left side.

Diagnosis: Nasopharyngioma.

Carcinoma of the hypophysis occasionally occurs and is similar to cancer in other parts of the body. No typical appearance is seen aside from irregular destruction which may involve any portion of the sella turcica and adjacent osseous structures.[26] The fossa often shows no evidence of enlargment, except possibly for slight deepening of the floor. Interestingly enough, Camp[6] has described destruction of the sella by metastatic disease from carcinoma of the breast and even from sarcoma originating in the retroperitoneum.

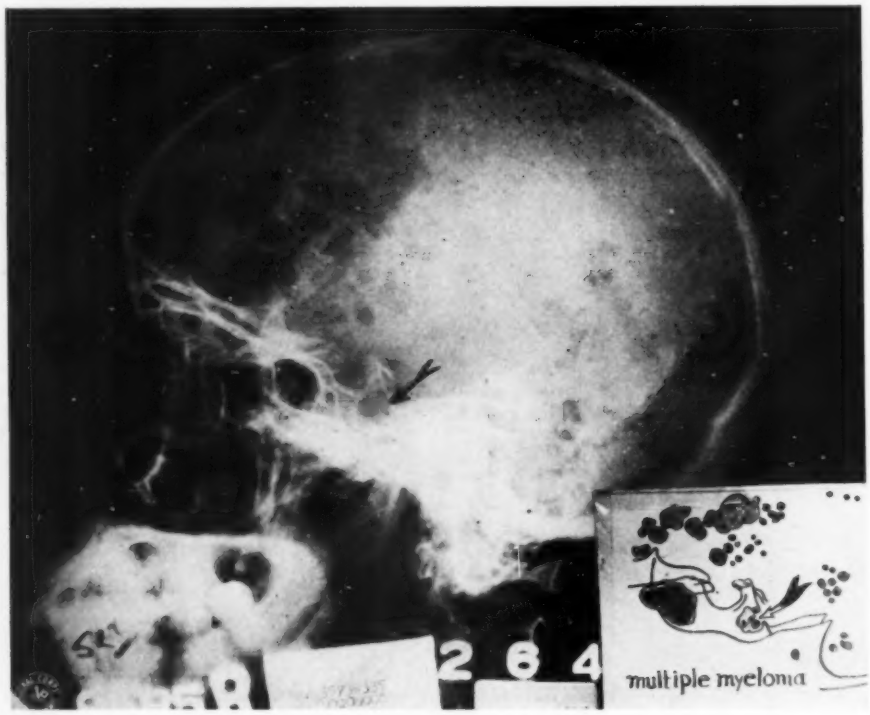


FIG. 13. Destructive lesion of the clivus due to multiple myeloma. Because of prominence of lesions in the calvarium changes in the region of the pituitary fossa are readily overlooked.

During the last year (1944) 360 cases of malignant disease have been treated in the Percy Jones General and Convalescent Hospital, Department of Roentgen Therapy. These represent, for the most part,

young adult patients. Seventy-nine of these (21.9 per cent) have had manifest evidence of metastatic disease. Few, however, have shown evidence of osteolytic change in the cranium. So far, destruction of the sella has occurred in only one individual. This patient has multiple circumscribed translucent areas involving the entire skeletal system. The roentgen picture is characteristic of multiple myeloma. The changes in the sella are unimportant clinically, but might readily be overlooked (Fig. 13). The following is a brief history:

A private, aged thirty-one, was admitted with history of chest and shoulder pain since January, 1944. He had "drawing pains" in the chest, and loss of appetite. Sternal biospy by Captain W. E. Peltzer revealed specific myeloma cells. Interesting laboratory findings are as follows:

1. Increase in total protein, which at one time reached 12.2 mg. per 100 cc.; 7.6 glob./4.6 alb.
2. No Bence-Jones proteinuria (50 per cent or less do not have a positive test).
3. Calcium as high as 19.1 mg.
4. Creatinin 3.4 mg. thought to be due to renal damage.
5. Elevated sedimentation rate, 44 mm. in 60 minutes.
6. Elevated blood cholesterol, 405 mg. per 100 cc.

Patient has shown striking improvement with roentgen therapy to entire body[13], plus conventional irradiation to other areas as symptoms demanded. The lesions in the cranium have regressed slightly with heavy roentgen therapy (2,000 r, air, to each of two large fields). It would appear that the lesions though controlled are relatively radioresistant.

Aneurysms of the circle of Willis will, if large enough, cause marked sellar deformation, and give rise to symptoms identical with those of pituitary tumor. Presumptive diagnosis can be made by finding curvilinear streaks of calcification in the aneurysmal sac on conventional roentgenograms. This must be differentiated from sclerosis without aneurysm which is usually asymptomatic. The latter is manifested by double striae of calcific density on a level with or just above the corticoclinoid foramens. There is a convex upward curve representing the arch of the carotid "siphon." By contrast, ossification of the interclinoid ligaments is likely to present a flat or concave superior border, lying more or less in the plane of the diaphragma. These linear areas of sclerosis may be projected over the internal aspect of the orbit in conventional posteroanterior studies, as indicated by Dyke.[12] For accurate localization of aneurysm, however, the method of choice

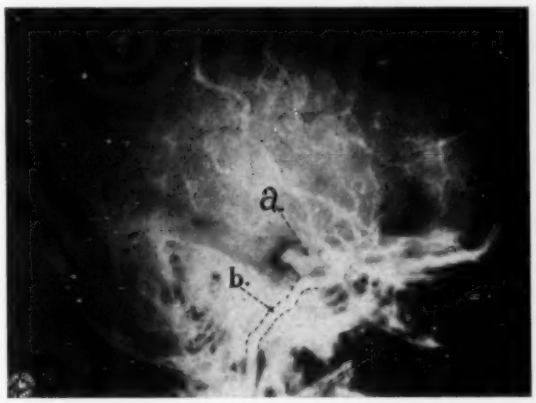


Fig. 14. Illustration showing aneurysm of the circle of Willis. Aneurysm at *a* and carotid siphon at *b*. Arteriogram was obtained after injection of diodrast into common carotid artery. (Courtesy W. B. Scoville, M.D.)

is that introduced by Egas Moniz in 1927. An excellent example of the accuracy with which such a lesion can be outlined is shown in Figure 14. A large aneurysm may cause hemiplegia due to pressure on the crus cerebri, congestion of the eye due to compression of the cavernous sinus, and severe headache due to leakage of blood into the subarachnoid space with resulting meningeal irritation. According to Pendergrass, "the opportunities for obtaining characteristic roentgen evidence are comparatively few."[26] This statement is significant since aneurysms of the circle of Willis are, for the most part, symptomless or silent except when they rupture. In this event the symptoms or signs are quite characteristic, causing ptosis, diplopia, pain

over the forehead and, as mentioned above, signs of acute subarachnoid hemorrhage. The diagnosis and localization of these lesions in intervals between hemorrhages usually requires angiography. Many patients may survive one or two episodes, but the eventual outcome is usually fatal hemorrhage—unless surgical excision or obliteration of the aneurysm is done. Therefore, arteriography should be carried out in patients who have survived a spontaneous subarachnoid hemorrhage, or in those who have had bouts of unilateral frontal pain associated with signs of involvement of the extra-ocular muscles, but without evidence of meningeal irritation.[21]

SUMMARY

1. The hypophysial fossas of young adult soldier patients have been measured in order to establish a standard. The average size was found to be anteroposterior 10.66 and depth 8.30 mm. with the following range:

Largest fossa—anteroposterior 13 ×depth 9 mm.
Smallest fossa—anteroposterior 8 ×depth 5 mm.

By comparison the average measurement of the fossas of six pituitary adenomas was anteroposterior 23 and depth 17 mm.

2. The normal variants observed have been considered and illustrated by line drawings for the purpose of clarity. One of these, the sinus of Berschet, is sometimes erroneously reported as the middle meningeal arterial channel. Another, the basilar sinus described by Batson and Kornblum, deserves wider recognition.

3. The ophthalmological considerations have been presented. *Choked discs are rarely seen with pituitary adenoma*, the important finding being a primary optic atrophy. Field changes may be simple or bizarre, depending on whether the area affected is the optic nerve, the optic tract, or whether the chiasm is involved alone or in combination.

4. Pathological changes in the pituitary fossa and its neighborhood have been briefly discussed and correlated with significant clinical findings.

The author wishes to acknowledge his indebtedness to Dr. Joseph C. Bell, Dr. Frank H. Mayfield and Dr. Paul Cusick for their valuable assistance in the preparation of this paper.

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THE ROENTGENOGRAPHIC APPEARANCE OF THE FALX CEREBRI

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SHADOWS due to the deposition of calcium in relation to the falx are frequently observed in roentgenograms of the skull. The shadow of the normal falx cerebri appears to have escaped recognition, although it is always visible in adequate anteroposterior or posteroanterior roentgenograms.

The falx is seen as a narrow thread-like shadow in the midline of the skull (Fig. 1).

FIG. 1. The normal falx cerebri as seen in a posteroanterior roentgenogram.

It extends above to within a centimeter of the vertex (where the dura splits to enclose the logitudinal sinus), and below, it disappears a variable distance above the crista galli or merges into the shadow of the bony ridge of attachment of the falx. In occipitofrontal roentgenograms the shadow may be seen extending throughout the cranial space above the shadow of the base. The shadow is of equal width in anteroposterior and posteroanterior roentgenograms. It corresponds in appearance and width with the shadow seen in encephalograms when gas occupies the subarachnoid spaces over the medial surfaces of the hemispheres. The shadow may sometimes be seen to deviate from the mid-plane of the skull, due to displacement caused by a space-occupying lesion. Pathological calcification plays no part in the production of the shadow, for it is seen in young children. When calcified plaques are present these lie alongside the falx rather than in it. In these cases the shadow of the remainder of the falx is no denser than usual.

It is believed that the shadow is due to the resistance opposed to the passage of roentgen rays by the dense fibrous tissue membrane. Figure 2 demonstrates that the normal falx is capable of absorbing rays sufficiently to cause a shadow. The dura mater of the vertex, including the falx, is removed and supported so that the falx is tightly stretched. A roentgenogram is taken. In Figure 2 the roentgen rays pass at right angles to the usual anteroposterior direction, and consequently through a much smaller depth of fibrous tissue. In spite of this, the shadow of the falx is as dense as that of the metacarpal bones. The following experiment shows that the falx is more resistant to the passage of roentgen rays than the normal brain. The falx is stretched horizontally behind a normal erect head in the anteroposterior position. A roentgenogram is taken with the tube at a distance of 6 feet. The shadow of the falx can be clearly seen.

The falx does not cast a shadow in lateral views because the depth of the tissue opposing the rays is only a very small fraction of that opposing the passage in roentgeno-

grams taken at right angles. The shadow is not seen in anteroposterior or posteroanterior roentgenograms in which the head is slightly rotated, nor when the tube has been shifted to one side for stereoscopic views. The absorption lessens as the plane of the falx deviates from the plane of the rays, for the rays pass through a smaller depth of tissue (Fig. 3). Also, the greater the rotation of the falx, the larger will be the area of projection upon the film, and consequently the more diffuse will be the shadow (Fig. 3).

The roentgenograms of 100 patients were examined to determine the frequency with which the shadow could be seen. In each, two or three roentgenograms had been taken either in a posteroanterior or anteroposterior direction. In 65 the falx could be clearly seen in one or more views. The greater the number of roentgenograms taken, the more likely is the falx to be seen in one of them. In 28 patients short shadows could be seen, sufficient, however, to determine position and direction of the falx. In 9 cases the falx was not seen. Examination of the roentgenograms in which the shadow was not seen suggested that slight rotation of the skull was the commonest cause of failure. Unusual density of the cranial bones, or a pronounced diploic pattern, may be sufficient to conceal the shadow of the falx.

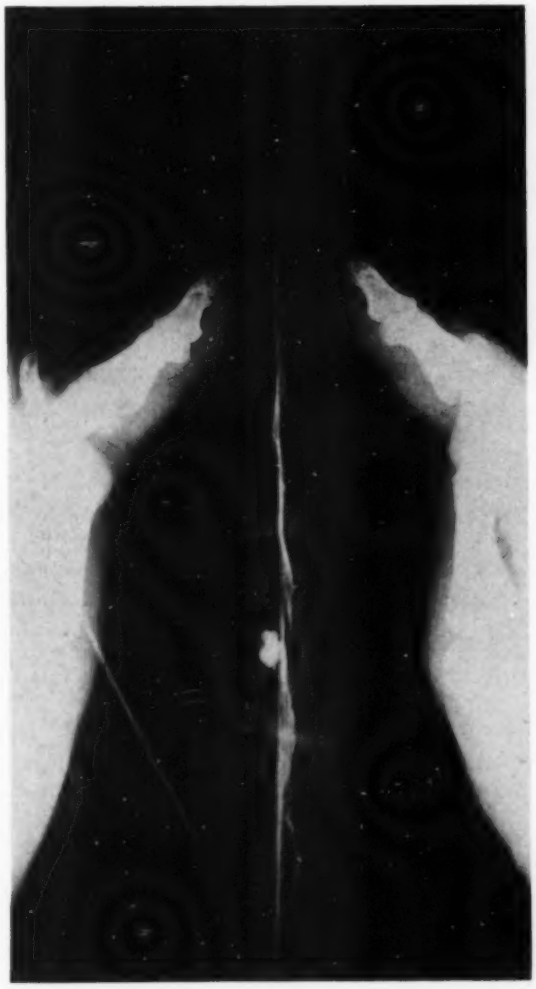

Fig. 2. Roentgenogram of the stretched falx cerebri. (The shadows of uniform density alongside the falx are due to supporting canes.)

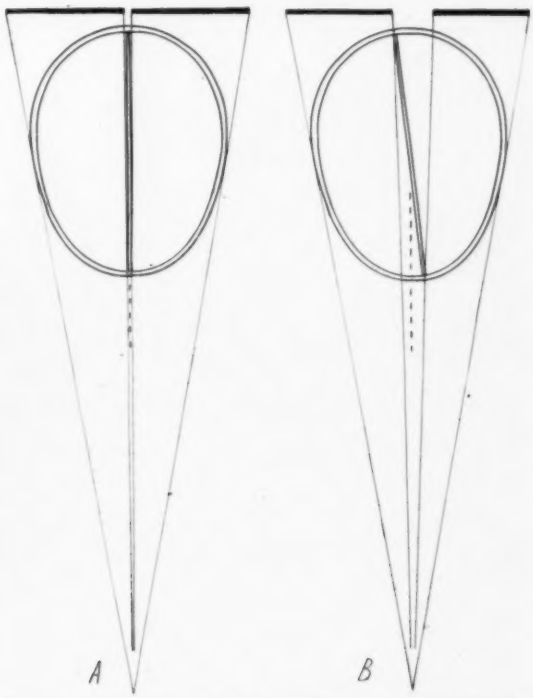

Fig. 3. Demonstrating the effect of imparallelism of the central ray and the falx. In (*A*) the rays are coplanar with the falx, and pass through the length of the falx. In (*B*) the rays pass only a short distance through the falx.

The shadow has considerable practical importance. Since the falx separates the two cerebral hemispheres it is a true indication of the position of the great longi-

tudinal fissure. This does not always coincide with the apparent midline of the skull drawn from bony landmarks. If the groove of the sagittal sinus is visible, the line of the falx will sometimes meet it to one side of the mid-point of the depression. The sinus itself is seen if calcium salts have been deposited along its dural walls, and occasionally, if a sufficient length of the sinus

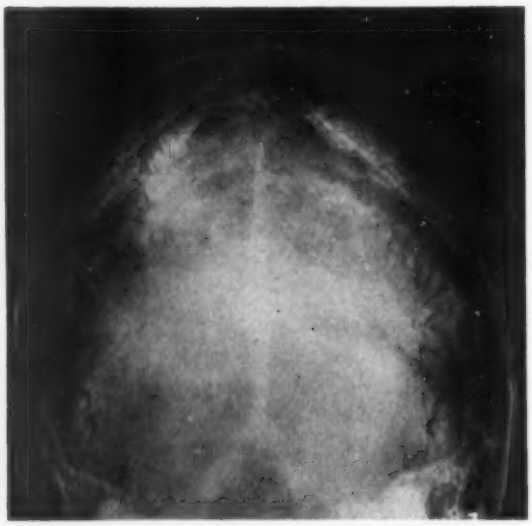

FIG. 4. Displacement of the falx produced by a left-sided parietotemporal cystic astrocytoma.

is along the plane of the rays, the divergent layers of the dura may be seen in the absence of calcification. The walls of the sinus and the falx do not always form a symmetrical Y.

The difficulty of determining the mid-plane of the skull and its occasional divergence from the cerebral midline leads to difficulty in recognizing small lateral displacements of the calcified pineal gland. If the pineal gland is in the line of a vertical undeviating falx, displacement is unlikely. In normal cases the line of the falx is a truer indication of the mid-plane than that drawn from bony landmarks. These points are dealt with more fully in "Further Contributions to Encephalography."*

However, the falx is not a rigid immobile structure. Hence, it is not an infallible index of the position of the mid-plane of the skull. The fibrous partition is sufficiently strong to oppose a considerable displacing force, while the cerebral tissues tend to herniate beneath the incisura tentorii away from the side of higher pressure. Hence the pineal gland may be displaced, while the falx remains in the mid-plane. As the displacing force increases, the falx also becomes displaced. Because the falx is displaceable, it may provide important evidence of the presence of a space-occupying lesion in patients in whom the pineal gland and choroid plexuses are not calcified. In several patients it has been of very great value. In 2 it served to provide evidence of the presence and position of subdural and extradural hemorrhages, and in another to provide conclusive evidence of the presence of a neoplasm, at a time when there was no definite evidence of increased intracranial pressure (Fig. 4).

The falx is visible in a smaller percentage of patients with cerebral tumors than in normal individuals. This is due to the fact that displacement tends to carry the falx out of the plane of the rays. No shadow will be visible unless a sufficient length of falx is situated along the plane of the rays. A tumor may cause the falx to bow to such a degree that the absorption of the rays is too slight and diffuse to be manifest. In some roentgenograms the falx was seen in the midline, in others a slant proved the presence and lateralization of an expanding lesion. The edges of the shadow were usually less sharp than when there was no displacement. In a few cases a double shadow could be seen. This appearance must be due to an accident of displacement, two areas being along the direction of the rays. In a consecutive series of 50 cases of proved neoplasms the falx was seen in 28 cases. In 15 it was central, in 13 displaced, and in the remaining 22 it was not seen. It is probable that the displacement of the falx explained the absence of the shadow in most of these cases.

* A monograph by the author to be published shortly.

It has not been possible to recognize a shadow corresponding to the tentorium, in spite of the taking of special roentgenograms. The tentorium is a curving partition and it is probable that there is insufficient membrane coplanar with the rays to cause appreciable absorption.

SUMMARY

The falx cerebri can be seen in a large percentage of properly taken roentgenograms of the skull.

The shadow is due to absorption of roentgen rays coplanar with the falx.

Imparallelism of the falx and the rays interferes with visualization.

In normal cases the shadow represents the true cerebral midline.

Displacement of the shadow is sufficiently frequent to make its recognition a valuable clinical sign.

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PRIMARY ATYPICAL PNEUMONIA

A DISEASE OF SEGMENTAL DISTRIBUTION*

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AN ANALYSIS of the roentgenographic manifestations of atypical pneumonia has been reported previously.[3] This further study is presented because it confirms the conclusions of the earlier contribution and, in addition, has clarified the anatomic characteristics of the disease which distinguish it from the lobar and lobular variants.

The previous paper, in accordance with the observations of others,[2,4,8] emphasized that (*a*) the process is usually basal, but the upper fields are not immune; (*b*) in the established case, as a rule, the roentgen opacity is homogeneous and translucent; (*c*) early characteristics are blurring of the structural markings fanwise from the hilum, and (*d*) resolution is almost a complete reversal, intensification of the bronchovasular markings being the last sign of previous parenchymal infiltration to disappear. Minimal atelectatic manifestations were observed with a frequency of 20 per cent; bronchiectasis was demonstrated in approximately 2 per cent of all cases.

Experience with the roentgen examination of the chest in approximately 1,000 cases of definite or clinically suspected atypical pneumonia permits the further generalization that this is essentially a pneumonia of segmental distribution. Illustrative cases will be cited to demonstrate this previously unreported fundamental fact.

THE BRONCHOPULMONARY SEGMENTS

The roentgen localization of intrathoracic disease requires familiarity with the distribution of the bronchial ramifications. Peirce and Stocking[9] have clearly demonstrated the right and left oblique projections of the thorax to be mose advantageous for full visualization of the bronchial tree, the secondary ramifications of which were named by these authors as follows:

RIGHT (Left anterior oblique projection—Fig. 1)	LEFT (Right anterior oblique projection—Fig. 2)
Upper Lobe	*Upper Lobe*
a. Ventral	a. Ventral
b. Apical	b. Apical
c. Dorsal	c. Dorsal
	d. Lingular
Middle Lobe	
a. Medial	
b. Ventral	
c. Axillary	
Lower Lobe	*Lower Lobe*
a. Apical	a. Apical
b. Dorsobasilar	b. Dorsobasilar
c. Axillary-basilar	c. Axillary-basilar
d. Ventrobasilar	d. Ventrobasilar

The above nomenclature is considered the most precise and practical of that in common use. It has been employed exclusively in this study and its validity is confirmed.

While oblique studies of the chest after lipiodol instillation most advantageously demonstrate the bronchial tree, the *frontal* view with appropriate *lateral* projections has been found best suited for routine localization, particularly the translucent parenchymal infiltrations of bronchogenic origin. The lateral roentgenogram also affords unrestricted visualization of the pulmonary fields behind the heart and below the summit of the diaphragm—areas which are obscured in the frontal view. Orientation is aided by knowledge of the location of the pulmonary fissures as seen in the lateral projection, the details of which

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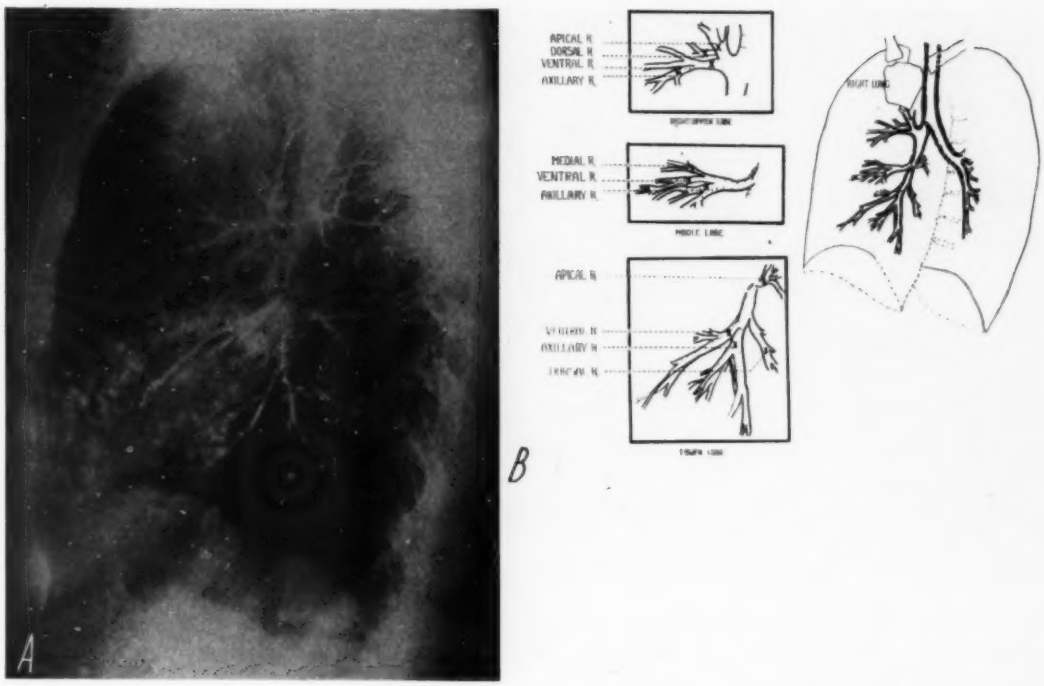

FIG. 1. (*A*) Left anterior oblique projection of chest demonstrates normal right bronchial tree. (*B*) Diagrammatic representation of structures shown in (*A*).

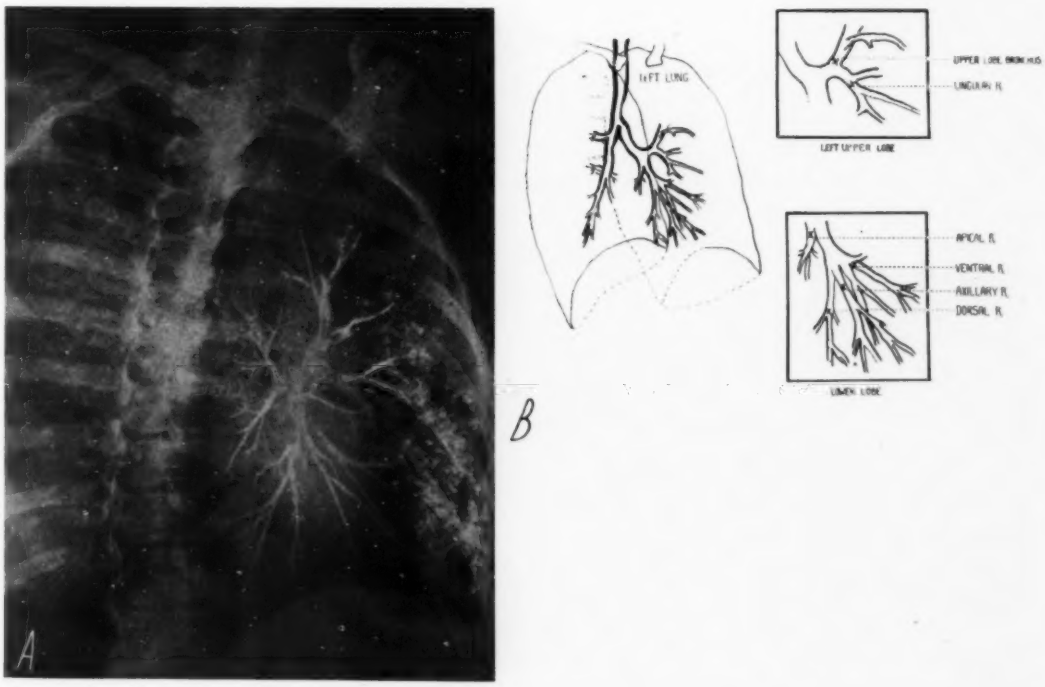

FIG. 2. (*A*) Right anterior oblique projection of chest shows normal left bronchial tree of same patient as in Figure 1. (*B*) Diagrammatic representation of structure shown in Figure 2 *A*.

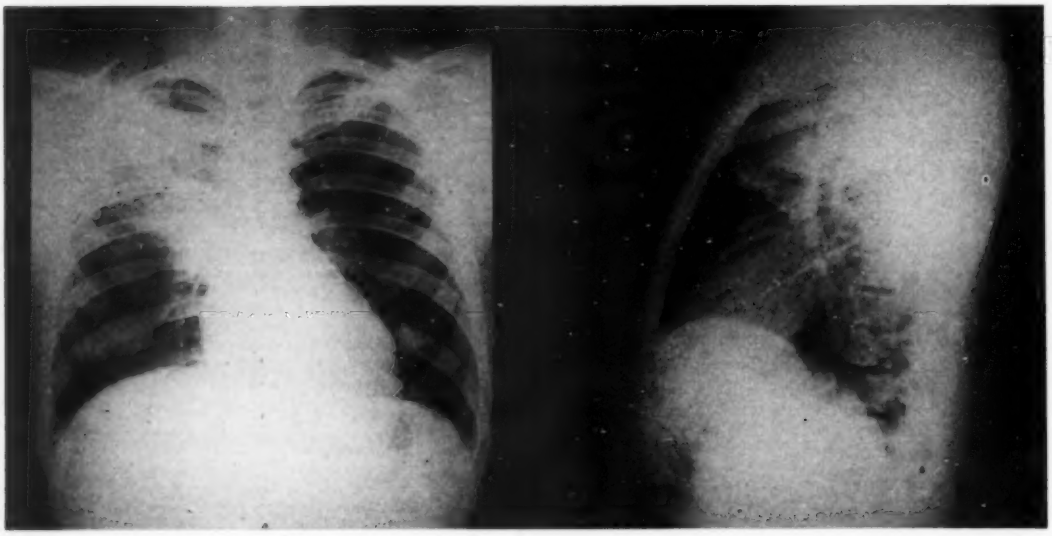

FIG. 3. Ventral segment of right upper lobe.

among others have been investigated by Levitin and Brunn,[5] Berry and Childs,[1] and Medlar *et al.*[7] The parentage of the bronchovascular markings should be kept in mind when the frontal study is inspected, as well as the projected periphery of the pulmonary fissures.

BRONCHOPULMONARY LESIONS

Atypical pneumonia occurs most frequently in the lower lobes where 80 per cent of the infiltrations are seen. The dorsobasilar is the most common segment to be involved.

It is to be noted that all bronchopulmonary segments supplied by the secondary bronchi are pyramidal with the apex directed toward the hilum where the secondary bronchi arise, the base facing a pleural surface. The length of the pyramid and the diameter of its base will vary with the particular segment concerned. Hence, the ventral segments of the upper lobes are of short stature and have a broad base, whereas the basilar segments of the lower lobes are long and tapering.

While the large majority of established infiltrations are confined to the bronchopulmonary segments supplied by a secondary bronchus, small lesions are occasionally seen involving only the cone supplied by a tertiary bronchus; the ventral segments of the upper lobes are excellent examples. The ventral ramus of each upper lobe bronchus divides into two principal branches which diverge at nearly a right angle—a ventral tertiary ramus and an axillary tertiary ramus. It is not uncommon to see either of these tertiary segments involved separately, or one involved in greater degree than the other.

The following illustrative cases have been selected from the series to demonstrate the segmental character of atypical pneumonia, and to further elucidate the bronchopulmonary anatomy.

Right Lung

Upper Lobe

(a) Ventral Segment (Fig. 3). When completely infiltrated this segment is seen in the right upper lung field, projected between the anterior arcs of the first to fourth ribs, limited inferiorly by the horizontal fissure and extended from mediastinum to axilla. The outline is roughly pyramidal in frontal projection with the ventral component viewed axially overlying the upper part of the hilum. The lateral view shows the pyramidal ventral tertiary segment running anteriorly from the upper extremity of the hilum and the axillary

component is seen end on, directed laterally from the same level and hence circular.

(b) Apical Segment (Fig. 4). This is infrequently involved but when seen the pyramid is viewed throughout its length in the frontal projection and is seen passing superiorly from the upper aspect of the hilum to the extreme apex. The lateral projection reveals the lesion passing upward somewhat obscured at the apex by the superimposed pectoral girdles.

(c) Dorsal Segment. No case of atypical pneumonia has been localized in this segment. This is perhaps significant, for all other secondary segments of the lungs have been demonstrated by infiltrative changes due to atypical pneumonia. Attention is called to the fact that the dorsal segment of the upper lobes is a common site of tuberculous infiltration.

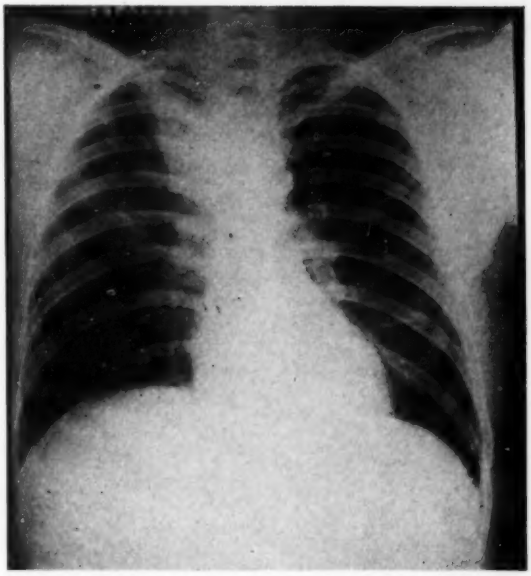

Fig. 4. Apical segment of right upper lobe.

Middle Lobe. Although in general all segments of the middle lobe can be fully surveyed in the frontal projection, the lateral view will serve to delineate the extent of the process in this lobe.

(a) Medial Segment (Fig. 5). This region extends inferiorly from the lower aspect of the hilum against the mediastinal surface to occupy the right cardiohepatic angle. In frontal view this pyramid is foreshortened since it is obliquely projected. The lateral view discloses the segment limited posteriorly by the lower extremity of the main fissure, anteriorly by the anterior surface and inferiorly by the diaphragmatic surface of the middle lobe. The ventral segment lies laterally.

(b) Ventral Segment (Fig. 6). In frontal projection this segment is also foreshortened since it likewise extends downward and forward from the lower end of the hilum, between the medial and axillary segments. It stops abruptly at the level of the anterior arc of the fifth rib and interspace, being the inferior limit of the middle lobe at this sector. In lateral projection the area is limited superiorly by the axillary segment, posteriorly by the lower end of the main fissure and anteriorly by the anterior surface of the middle lobe.

(c) Axillary Segment (Fig. 7). As named, this

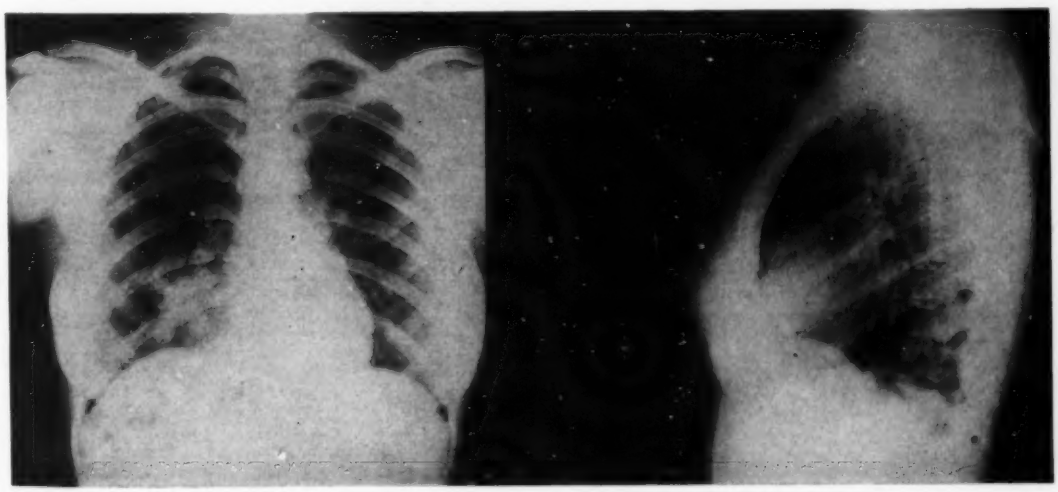

Fig. 5. Medial segment of right middle lobe.

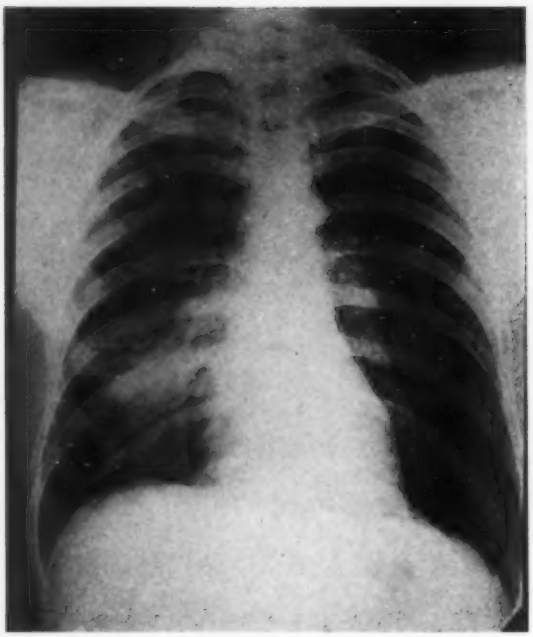

FIG. 6. Ventral segment of right middle lobe.

segment extends directly laterally from the hilum and in frontal view is projected in complete profile, apex directed toward the hilum and the base extending to the inferolateral surface of the middle lobe. The segment is sharply defined superiorly by the minor fissure, and lies adjacent to the ventral segment inferiorly. The lateral projection reveals the posterior limit to be that portion of the main fissure just below the hilum and above the dome of the diaphragm.

Lower Lobe

(a) Apical Segment (Fig. 8). Embryologically, this segment develops as a separate unit and is said to occasionally possess a fissure which limits it from the remainder of the lower lobe. This segment is a frequent site of lung abscess, a fact which is made apparent when it is recalled that the right apical bronchus is easily entered by infected secretions or small foreign bodies when the patient is either supine or standing.

In frontal view the segment when involved by infiltration is seen axially, hence circular in contour, projected between the eighth and ninth costovertebral junctions and extending from mediastinum to axillary one-third of the lung field. The upper and outer boundary of the segment is defined by the apex of the lower lobe, which it will be recalled passes in an arc laterally and inferiorly, thereby limiting the process to the medial two-thirds of the lung field. Since this segment overlies and frequently obliterates the hilum, it is probable that infiltrations of this segment have been incorrectly termed "hilar pneumonia." Lateral projection reveals the true state of affairs where the apical segment is seen as a squat pyramid extending

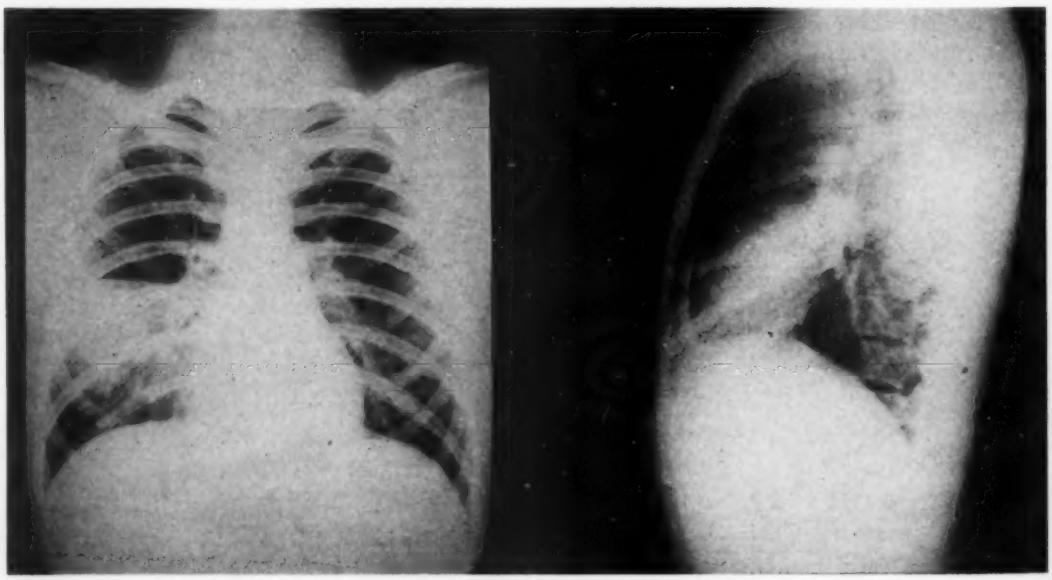

FIG. 7. Axillary segment of right middle lobe.

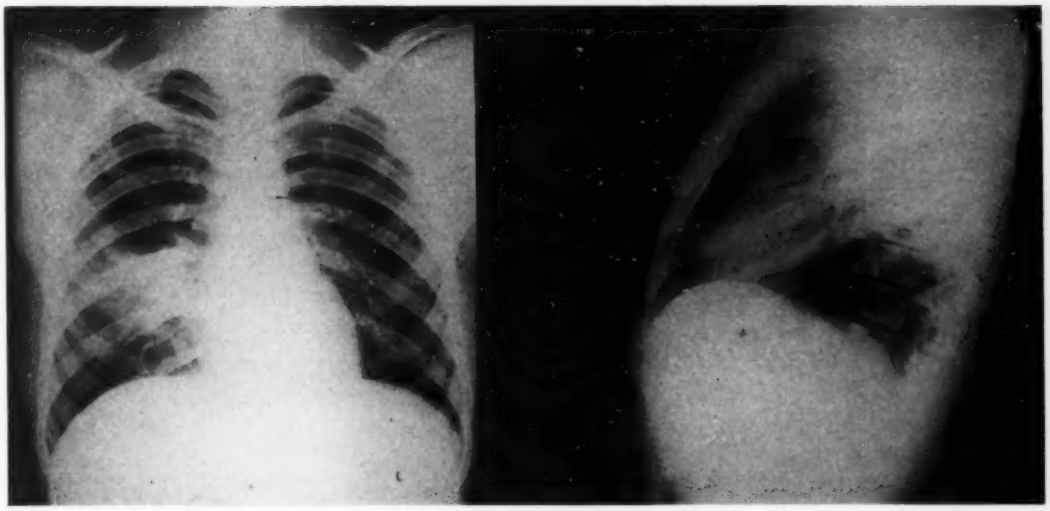

Fig. 8. Apical segment of right lower lobe.

directly posteriorly from the hilum with its base facing the posterior surface of the lung. Inferiorly the segment lies adjacent to the basilar divisions.

(b) Dorsobasilar Segment (Fig. 9). This is the commonest site of atypical pneumonia. It is commonly obscured by the summit of the diaphragm and the cardiac shadow, particularly on the left side. The segment extends inferoposteriorly with its apex at the lower hilar extremity. In frontal view, the segment occupies the posteromedial portion of the lower lobe, projected at the cardiohepatic angle in a manner similar to that of the medial segment of the middle lobe. The lateral projection clearly localizes the segment extending downward and back to the posterior costophrenic angle, well below the summit of the diaphragm.

(c) Axillary-Basilar Segment (Fig. 10). This area is clearly identified in the frontal projection where it is seen as a pyramid extending inferiorly and laterally from the hilum, with the apex directed centrally and the base occupying the lateral costophrenic angle. This accurately places the segment in the lower lobe as the inferolateral extremity of the middle lobe falls

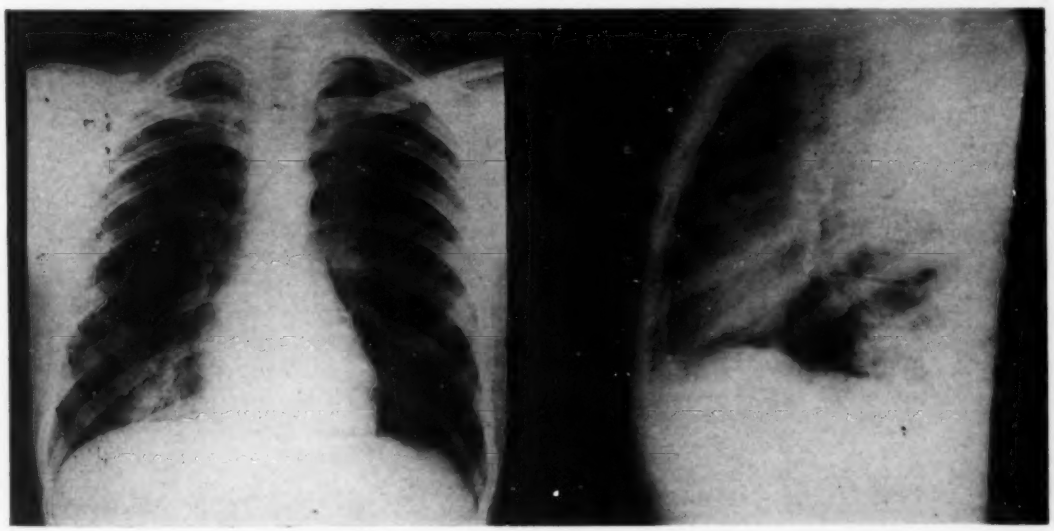

Fig. 9. Dorsobasilar segment of right lower lobe.

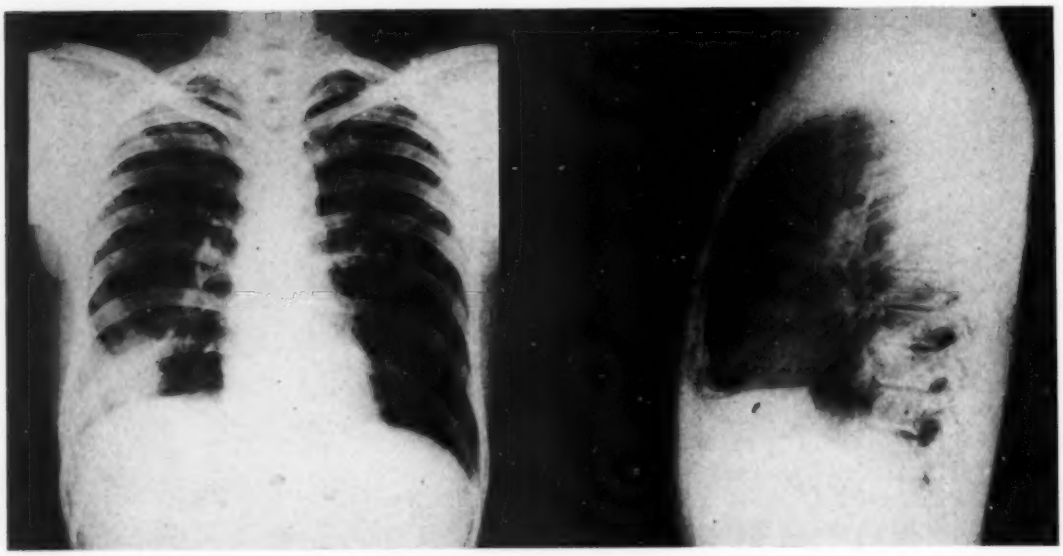

FIG. 10. Axillary-basilar segment of right lower lobe.

considerably short of the lateral costophrenic angle. The lateral projection reveals the process to lie posteriorly but in a plane just anterior to that of the dorsobasilar segment.

(d) Ventrobasilar Segment (Fig. 11). In frontal view, this unit is projected in a position midway between the dorsal- and axillary-basilar segments. Seen in the lateral roentgenogram, the ventrobasilar segment lies almost in a vertical plane extending inferiorly and slightly forward from the hilum to the summit of the diaphragm: thus it is ventral to the dorsobasilar and axillary-basilar components with its anterior boundary furnished by the inferior extremity of the main fissure.

Left Lung (Fig. 12–19)

The segmental distribution of the left lung is in large part similar to the right, the outstanding anatomical difference being the lingular segment which is homologous to the right middle lobe.

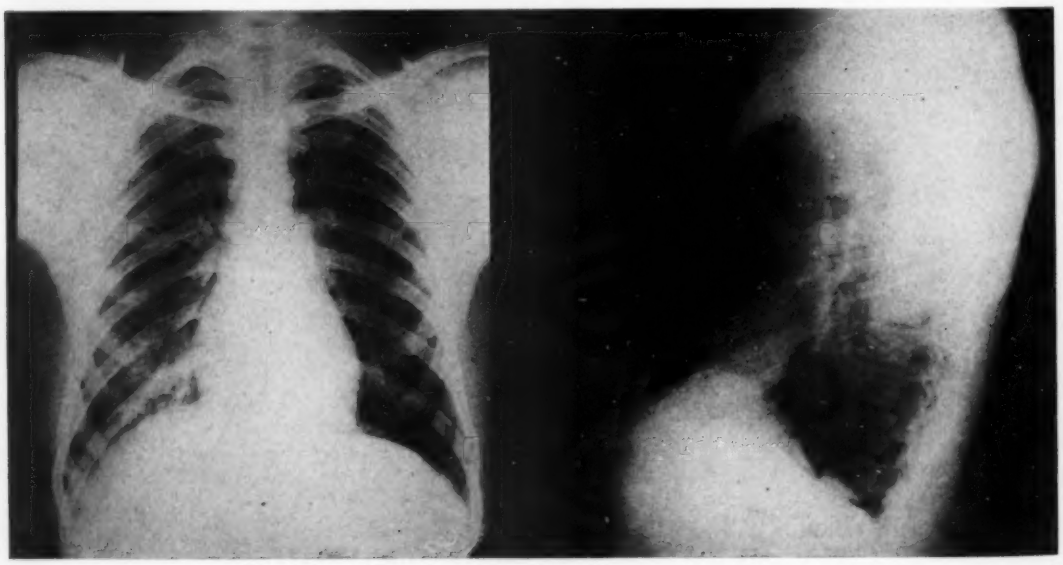

FIG. 11. Ventrobasilar segment of right lower lobe.

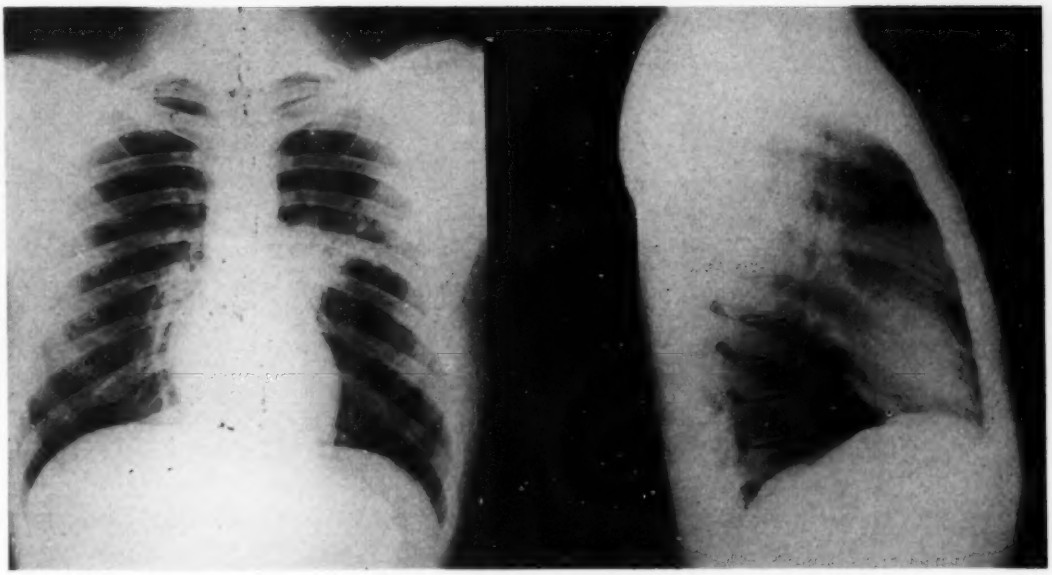

Fig. 12. Ventral (tertiary) segment of left upper lobe.

Lingular Segment (Fig. 14). The bronchus supplying this segment arises from the left upper bronchial trunk and supplies the infero-lateral third to half of that lobe. The segment extends to the diaphragmatic surface medially, arching laterally and upwards in much the same manner as the right middle lobe. The lingular bronchus ramifies into median and axillary divisions, the first supplying the lung parenchyma adjacent to the left cardiac border, the second extending to the lower axillary lung field, but never to the costophrenic angle. It follows that an infiltration confined to this segment occupies the medial and basal lung field beside the cardiac border and extends laterally toward the axillary zone, upward to

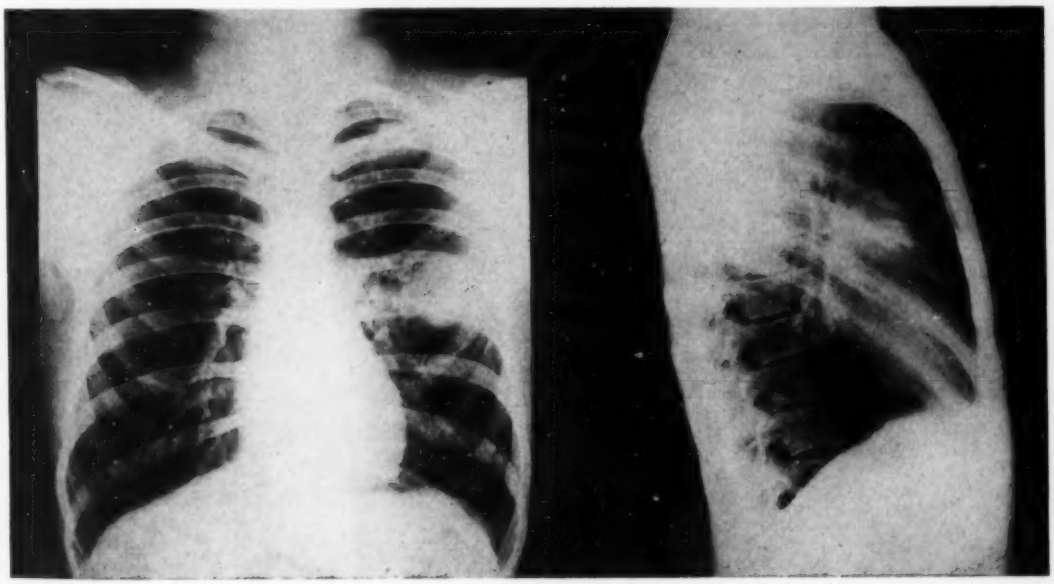

Fig. 13. Axillary (tertiary) segment of left upper lobe. The ventral and axillary tertiary segments of the upper lobes constitute the ventral secondary segment—see text.

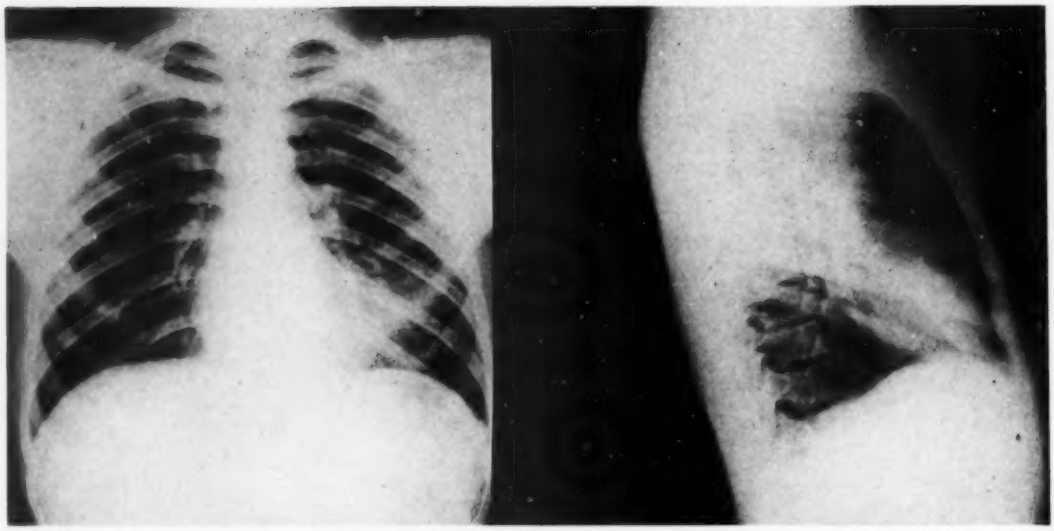

FIG. 14. Lingular segment of left upper lobe. Note the smaller diaphragmatic surface of this segment in comparison to that of the right middle lobe.

the third intercostal space. The median component occupies the left cardiohepatic angle in much the same manner as the medial segment of the middle lobe occupies the same angle on the right. In lateral projection the tongue-like shadow extends downward and forward from the hilum. The posterior boundary is the lower part of the main fissure; anteriorly is the pleural surface and above lies the ventral segment. Resolution of atypical pneumonia in this segment is frequently delayed. In bronchography, careful attention should be given to the lingula for it has been observed to be rather frequently involved in bronchiectasis either alone or along with the basilar rami.

Left Dorsobasilar Segment (Fig. 17). This segment, while posterior, is also projected in the cardiohepatic angle but never extends as far laterally as the lingula. Frequently it is hidden by the cardiac apex. The lateral projection provides an unrestricted visualization of the segment and has not infrequently been

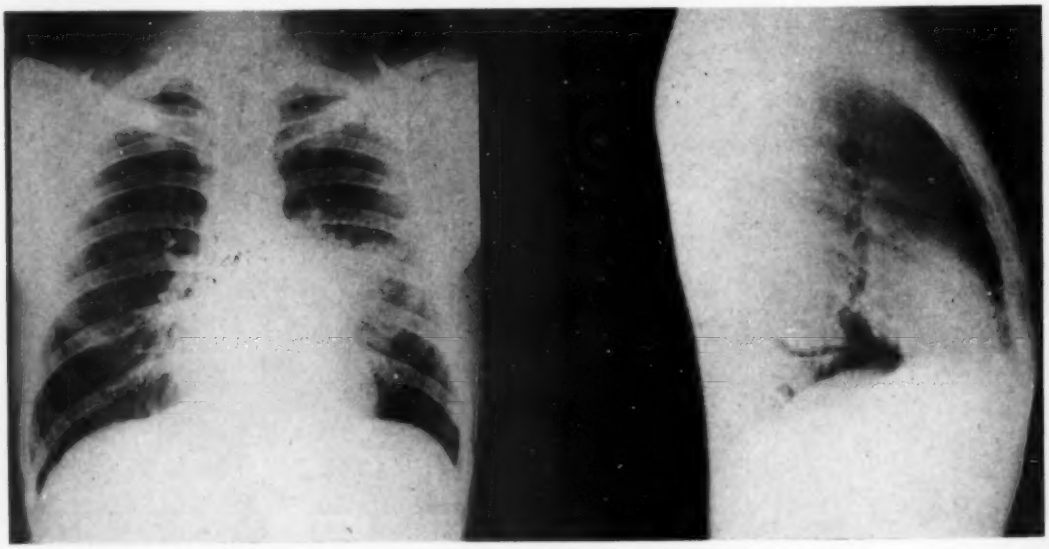

FIG. 15. Apical segment of left lower lobe.

FIG. 16. All basilar segments of left lower lobe. Note that the lower end of the main fissure is displaced posteriorly due to accompanying atelectasis.

the sole clue to the correct diagnosis. This perhaps explains the discrepancy occasionally described between the clinical and roentgen findings when the lateral study has been omitted.

The Apical Segments of the Lower Lobes (Fig. 8 and 15). In this series the apical segment of the right lower lobe has occupied a consistently lower position than the left, the projected upper boundary on the right being

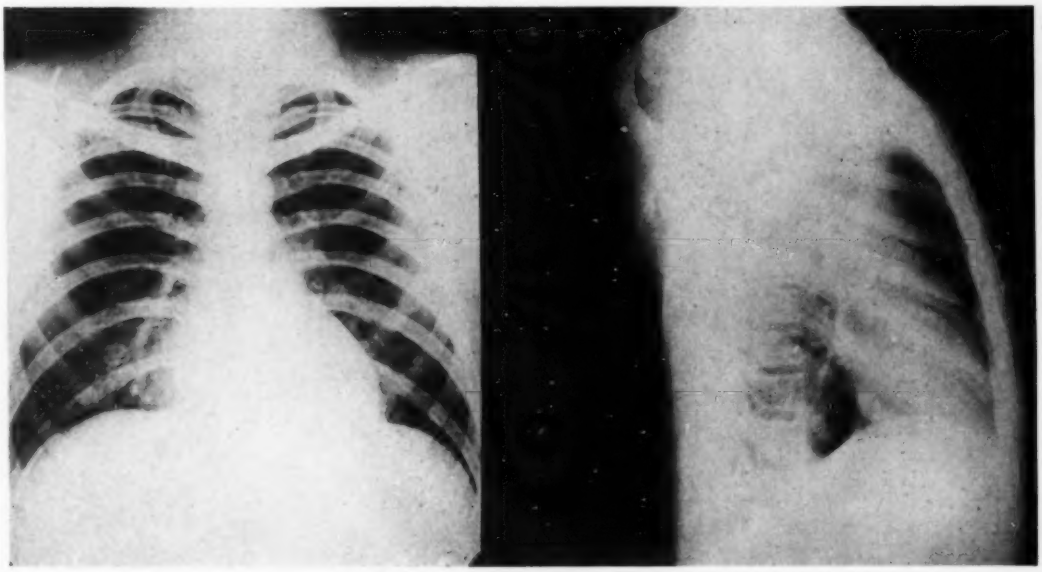

FIG. 17. Dorsobasilar segment of left lower lobe. The lateral study clearly reveals the infiltration to lie behind the heart and below the summit of the diaphragm. These areas are not seen in the frontal view which accounts for the absence of infiltrative changes in this projection.

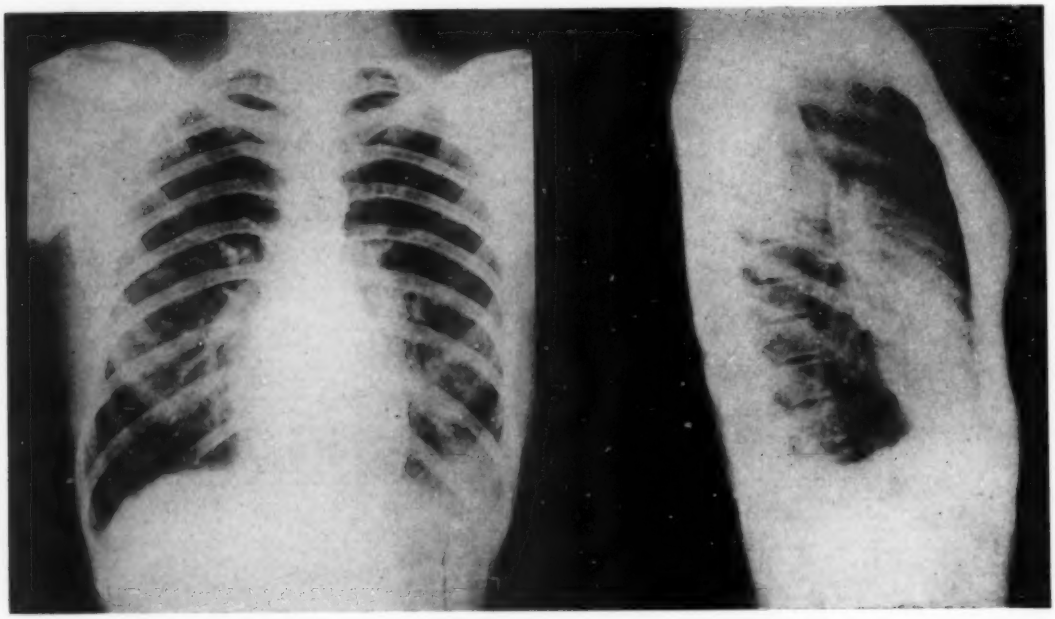

FIG. 18. Axillary-basilar segment of left lower lobe.

at the eighth posterior costovertebral junction in comparison with the sixth on the left. The combined volumes of the right upper and middle lobes is greater than that of the left upper lobe which probably accounts for the discrepancy.

DISCUSSION

It is generally agreed that "atypical" pneumonia is manifested on roentgen examination as a peribronchial infiltration which usually coalesces as a homogeneous translucent opacity. This conception differs little from that of bacterial broncho-pneumonia (lobular pneumonia) which commonly involves the parenchyma similarly but without strictly confining its

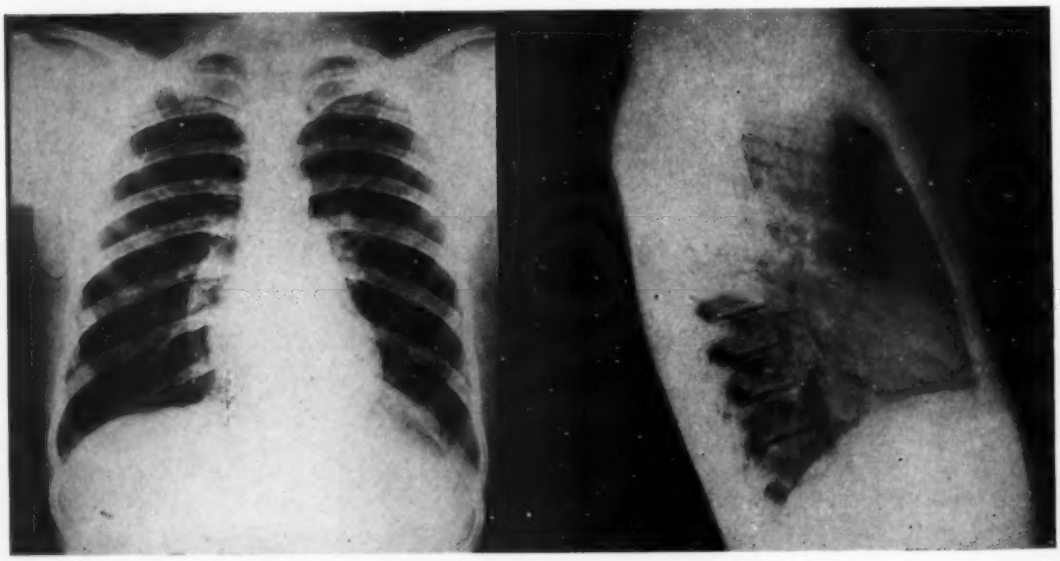

FIG. 19. Ventrobasilar segment of left lower lobe.

boundaries to either a single lobe or segment thereof. The present study has clearly demonstrated atypical pneumonia to differ sharply from lobar and lobular types by its bronchopulmonary segmental nature. This feature is unique; accordingly the disease should be considered a confluent lobular infiltration characterized by a marked segmental distribution.

It is significant that such infiltrations are most common in the basilar pulmonary areas, for in the series observed the upper lobes were involved infrequently, and in no case was the process identified in their dorsal segments. Evidence such as this suggests that the disease results from aspiration of the infective agent to cause a descending bronchogenic infection of the pulmonary parenchyma. This conception is further enhanced by the occurrence of minimal atelectatic phenomena which is probably responsible for the infrequent establishment of bronchiectasis.

That the dorsal segments of the upper lobes were not involved by atypical pneumonia is of some diagnostic significance for they are favorite sites of pulmonary tuberculosis. Recheck in ten days, however, is sound advice when the latter diagnosis is suspected.

The factor responsible for the discrepancy in the levels of the extreme apices of the lower lobes has been considered. In addition they have been observed to occupy a somewhat lower level (eighth costovertebral junction on the right, sixth on the left) than that generally reported (third and sixth costovertebral junctions). The latter determinations were obtained from autopsy material whereas this study has been performed on living subjects who were roentgenographed in the erect position during suspended deep inspiration. The upright position unquestionably elongates the thoracic viscera and probably lowers the apices of the inferior lobes from their position with the subject prone. Macklin's work[6] supports the view of a lower position for the apices during inspiration. The lower lobe bronchi have been demonstrated by him to lengthen in an inferolateral direction during inspiration which must necessarily cause similar displacement of the apical together with the adjacent segments relative to the fixed position of the costovertebral junctions. Finally, these observations have been confirmed in a case of atypical pneumonia involving the apical segment of the left lower lobe: Roentgenograms were taken with the patient prone during suspended expiration and in the conventional pose, while standing during suspended deep inspiration. In the former instance, the apex was at the third posterior interspace and in the latter at the sixth costovertebral junction.

While atypical pneumonia is of less significance in civilian than in military practice, similar bronchopulmonary lesions form a significant quota of intrathoracic disease, e.g., pulmonary tuberculosis, bronchial tumors, bronchial stenosis, bronchiectasis, bronchial foreign bodies. Thus, it is felt more thought should be placed on the segmental anatomy of the lung, particularly from the standpoint of localization, thereby rendering further assistance to the thoracic surgeon as well as to the internist. The physical signs elicited on clinical examination of the chest are of greater significance when considered in the light of segmental anatomy as shown in this series.

SUMMARY AND CONCLUSIONS

1. In the established case, the roentgen opacity produced by atypical pneumonia is homogeneous and translucent; early changes cause blurring of the bronchopulmonary markings; resolution is almost in reverse order, structural intensification being the last sign of previous parenchymal infiltration to disappear.

2. By routine use of the appropriate lateral projection of the chest in conjunction with the conventional frontal study, it has been abundantly demonstrated that the infiltration of atypical pneumonia is

segmental in type, the distribution being closely related to the zones supplied by the secondary rami of the bronchial tree. That the disease is one of bronchogenic origin is further attested by the frequent occurrence of minimal atelectasis and followed infrequently by secondary infection and development of bronchiectasis.

The intralobar septa probably serve as limiting boundaries to the characteristically preponderant interstitial reaction. The disease should therefore be considered anatomically as a confluent lobular pneumonia of segmental distribution in contradistinction to the lobar and lobular variants.

3. Consideration has been given to the position of the apex of the lower lobes.

4. The value of the lateral study of the thoracic viscera has been amply demonstrated in this series. Its use in routine study of pulmonary disease is strongly recommended.

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Vol. 56, No. 3

ROENTGENOLOGIC STUDIES ON THE EFFECT OF SYNTHETIC FOLIC ACID ON THE GASTRO-INTESTINAL TRACT OF PATIENTS WITH TROPICAL SPRUE*†‡

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WE HAVE observed that a profound improvement occurs in the glossitis as well as in symptoms referrable to the gastrointestinal tract of patients with nutritional anemia and pernicious anemia when treated with synthetic folic acid.[1] Early in our studies concerning the effect of folic acid on the anemia of tropical sprue we were impressed by the severity of the gastrointestinal complaints in these patients and we endeavored to determine what changes, if any, occurred in alimentary tract function when this substance was used as the only treatment. Although many patients with tropical sprue were studied from this point of view, the present report is limited to our observations on 2 patients with severe tropical sprue who were studied roentgenographically before, during, and after therapy with folic acid. As a means of comparison, a study on a normal control and on a positive control who received no specific therapy is also included in this report. Using the following criteria 3 patients with tropical sprue were selected for study:

1. The patient must have glossitis.
2. He must have diarrhea, characterized by voluminous, foul smelling, frothy, liquid, yellow stools.
3. The stools must have an increased fat content as determined by chemical analysis.
4. A body weight loss of at least 20 pounds must have occurred during the six months preceding the initiation of this study.
5. He must have a macrocytic hyperchromic anemia with a red blood cell count of 2.5 million or less and a color index of 1.0 or more.
6. There must be megaloblastic arrest of the sternal bone marrow.
7. There must be free HCl acid present in the gastric juice on fractional analysis after histamine stimulation.
8. The oral glucose tolerance curve must be flat.
9. The blood calcium level must not be below 8.5 mg. per 100 cc.
10. The serum amylase and lipase activity must be normal.
11. The patient must not have had specific therapy within the five weeks preceding the study.

Each patient thus selected was hospitalized and received a daily diet which contained no meat, meat products, fish or fowl, and which allowed one egg and one pint of sweet milk. Prior to the initiation of therapy baseline clinical, laboratory and hematological studies were done as previously described.[2] In addition to these studies, routine gastrointestinal roentgen series were performed. These series were repeated again during the course of therapy with folic acid and also after clinical and hematological recovery were complete.

The routine roentgen examination procedure was as follows. The patient was

* University of Cincinnati Studies in Nutrition at the Calixto Garcia Hospital, Havana, Cuba, in cooperation with the Institute of Nutrition of Cuba and the University of Havana.
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‡ The folic acid for the study was supplied by Lederle Laboratories, Inc.

FIG. 1. Case 1.

denied everything by mouth after 7 p.m. the night before the examination. At about 8:30 a.m. the day of the examination he was given the contrast medium which consisted of 100 gm. of chemically pure barium sulphate, suspended in 150 cc. of water. No other ingredients were added to this medium. Roentgenograms taken at fifteen minutes, forty-five minutes and one hour after the contrast medium had been ingested and each hour thereafter until the head of the barium column reached the cecum. Rigid adherence to this schedule was not feasible in some cases because of the great degree of intestinal hypomotility. In such instances it was necessary to select time intervals more suitable to each patient.

FIG. 2. Case 1.

FIG. 3. Case 1.

CASE 1 was a normal control who had no condition which might possibly have resulted in altered alimentary tract function nor was there a past history of such a condition. Using the procedure described above a complete gastrointestinal roentgen series was obtained as a means of comparison and in order to demonstrate the findings in a normal individual. Figures 1 and 2 show that the passage of barium through the central and distal portion of the jejunum is normally quite rapid. The jejunum is seen to be of generally greater diameter than the ileum and the mucosa of the jejunum is

normally well visualized, whereas that of the ileum is not. The two figures (Fig. 1 and 2) demonstrate the normal continuous, connected barium column in the small intestine; this column is never fragmented nor interrupted normally. After the barium has passed from one portion of the jejunum to another there may be seen many very fine, small, almost invisible deposits of contrast medium among the recesses between the folds of the jejunum in some cases.

Fig. 4. Case II.

This trace of barium is normal. The head of the barium column usually enters the cecum within two hours after ingestion, as shown in Figure 3. This is considered the normal time interval for this passage in residents of Cuba and by this means we measured intestinal motility.

Case II (F. P.) fulfilled our criteria for tropical sprue and was used as a positive control. He received no specific therapy during this study. The first gastrointestinal roentgen series was done on January 28, 1946. Figure 4 represents the thirty minute roentgenogram and shows the stomach and duodenal cap almost free of barium. A "stack of coins" and "wheel" effect, both of which in reality are the result of mucosal edema, can be seen in the proximal portion of the jejunum. Alternating intestinal spasm and

Fig. 5. Case II.

dilatation is clearly seen in Figure 5. At the end of one hour there was a striking distribution of the barium into numerous, irregularly shaped

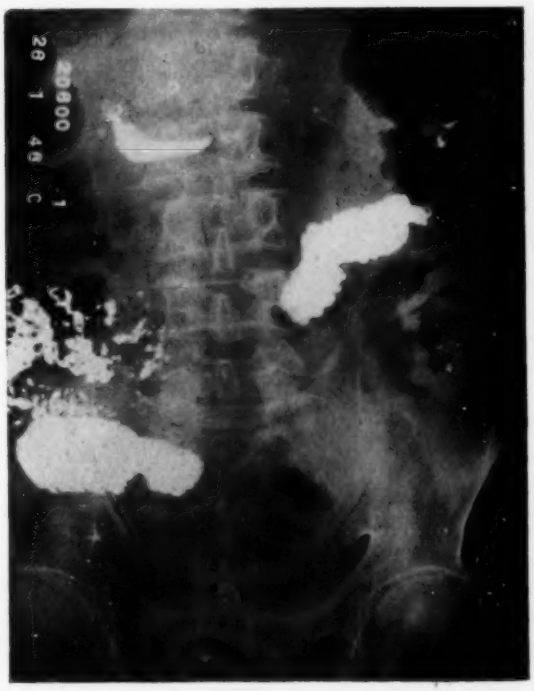

Fig. 6. Case II.

FIG. 7. Case III.

clumps of barium, an appearance which warrants the descriptive term "moulage" or "clumping" of barium. These findings are shown in Figure 6. The general conclusions in this first series of roentgenograms were intestinal hypomotility, mucosal edema, and alternating areas of intestinal dilatation and spasm. A second series of roentgenograms were taken on February 16, 1946, and there was essentially no change. The third and last series was done on March 9, 1946, and there was no change except for very slight improvement in intestinal motility. Segmentation and fragmentation of the barium column was as severe at the time of this examination as it was in the initial series.

FIG. 8. Case III.

FIG. 9. Case III.

CASE III (E. V.) had severe tropical sprue. He was roentgenographed on February 7, 1946, prior to receiving any specific therapy. The intestinal mucosa was edematous and irregular. There were numerous, isolated, dilated segments of jejunum filled with barium which were connected by thin bands of spastic jejunum, and the barium showed a severe degree of puddling (Fig. 7). There was a great degree of intestinal hypomotility, the head of the barium column still not having reached the cecum at the end of two hours (Fig. 8). These studies were repeated on March 9, 1946, after thirty-four days of treatment with 10 mg. of folic acid by mouth. There was striking improvement as evidenced by more normal con-

tinuity of the column of barium, less mucosal edema and mush less segmentation (Fig. 9). The head of the column of barium had reached the cecum in less than four hours, showing improvement in intestinal motility. The third roentgen series was done on April 13, 1946, after sixty-nine days of treatment with folic acid. At this time the roentgenograms showed an almost complete reversion to normal (Fig. 10). Intestinal motility was normal, the barium reaching the cecum in two hours, the mucosa was only

Fig. 10. Case III.

slightly edematous in several small areas and there was a minimum of segmentation of the column of barium.

Case IV (C. C.) had classical tropical sprue in relapse. His first series of gastrointestinal roentgenograms were taken on January 2, 1946, before any treatment was given. Figure 11 shows segmentation of the barium, alternating intestinal spasm and dilatation, edema of the mucosa of the jejunum, and atrophy of the mucosa of the ileum. Intestinal hypomotility was severe. On February 16, 1946, after eighteen days of treatment with folic acid in daily oral doses of 10 mg., a second series of roentgenograms were taken. Most of the alterations described above in the baseline roentgen series were present in this series also, but to a much

Fig. 11. Case IV.

less degree (Fig. 12). Intestinal motility was improved, the barium reaching the cecum in less than four hours. On April 12, 1946, after

Fig. 12. Case IV.

FIG. 13. Case IV.

seventy-two days of treatment with folic acid a third series of roentgenograms were taken. The mucosa of the small intestine was essentially normal but there were still a few areas of isolated intestinal spasm and dilatation (Fig. 13). Intestinal motility was greatly improved, the barium having reached the cecum in one and one-half hours.

CONCLUSION

Synthetic folic acid in daily oral doses of 10 mg. has a profound effect on the alimentary tract function of patients with tropical sprue in relapse. Repeated roentgen studies on Case II, who had tropical sprue but who did not receive folic acid, showed no improvement within a similar period of time. In contrast to this positive control, Cases III and IV showed striking improvement which was evidenced by return of intestinal motility toward normal and the establishment of a continuous column of barium which was not interrupted by segmentation or fragmentation. The roentgenographic findings most often observed in this series of patients with tropical sprue are mucosal edema, intestinal segmentation with alternating intestinal spasm and dilatation and intestinal hypomotility. These abnormal roentgen-ray patterns could very well be the result of nutritional disorder, hypoproteinemia, disease of the liver, disease of the mesentery, or any disease condition which may produce submucosal edema,[3] but in these cases the response to synthetic folic acid was dramatic.

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RETICULO-ENDOTHELIOSIS

WITH REPORT OF TWO CASES*

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SINGLE or multiple granulomatous lesions of bone with or without soft tissue involvement, diabetes insipidus or exophthalmos, have been variously classified as certain forms of xanthomatosis, Hand-Schüller-Christian's disease, Letterer-Siwe's disease, lipoid histiocytosis, lipoidosis, lipoid granulomatosis, eosinophilic granuloma, solitary granuloma and reticulo-endotheliosis.

There have been many varied explanations given as to the causative factors in this group of diseases. The Hand-Schüller-Christian syndrome occurs more commonly than other members of this group. At first it was believed that this condition was due to a pituitary dysfunction. Rowland's[27] investigations in 1928 led him to believe that the findings were primarily those of a disturbed lipoid metabolism and that the resulting granulomatous lesions were a hyperplastic reaction of the reticulo-endothelial system produced by a lipoid infiltration. He felt that the primary causative factor was an excess ingestion of fatty foods. Sosman[30] classified xanthomatosis as a disease of lipoid metabolism and subdivided it into five clinical entities: (Gaucher's disease; Niemann-Pick's disease; Schüller-Christian's disease; xanthomas occurring in diabetes, icterus, and pregnancy; and essential xanthomatosis). Chester and Kugel[2] described these lesions as non-infectious bacterial inflammatory granulomata due to the deposition of various lipoid substances in the involved areas. Teperson[33] also felt that xanthomatosis represented a constitutional disturbance of fat metabolism with a storage of excess fats in the reticulo-endothelial and histiocytic systems. Hilton and Eden[15] expressed a similar opinion.

Sosman[31] stated that the essential for producing xanthomatosis was either a hypercholesterolemia or a normal body fluid cholesterol with traumatized or suppurative areas capable of storing it as a foreign body. He stated that the characteristic xanthoma or "foam cells" were not always observable. Thannhauser[34] felt that this group of diseases was a heredofamilial constitutional disorder of the intracellular metabolism, and that the substances accumulated in the cell were not supplied by the blood stream but were a result of disturbances in the cellular lipoid metabolism.

As early as 1934, Grady and Stewart[10] stated that a relationship between non-lipoid histiocytosis and Hand-Schüller-Christian's disease might exist. Strong[32] (1936) expressed the opinion that the reticulo-endothelial system probably played a large part in these diseases and questioned the existence of a definite relationship with lipoid metabolism.

Other investigators[13,14,35] proposed that these clinical entities were not necessarily disturbances of lipoid metabolism and preferred to classify them as primary diseases of the reticulo-endothelial system. It was felt that they represented variants of the same basic disease process and that there were insufficient grounds to warrant their separation into specific disease entities. This view was not supported by Lichtenstein and Jaffe[22] who coined the term "eosinophilic granuloma" to classify single granulomatous lesions of bone as a distinct disease entity not related to xanthomatosis.

Currens and Popp[4] stated that the etiology was obscure but mentioned that the pathology frequently suggested that the disease might be an infectious type of granuloma. The finding of large amounts

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of lipoid in some of the lesions has been the main evidence for regarding Hand-Schüller-Christian's disease as a lipoid metabolic disorder. Cowie and Magee[3] made a study of the lipoid content of various tissues in a case of Hand-Schüller-Christian's disease and in a control case of similar age and anemia. They found no essential differences in the lipoid content of the tissues with the exception of the xanthomatous masses. Gross and Jacox[13] felt that Hand-Schüller-Christian's disease was a chronic form of reticulo-endotheliosis and that Letterer-Siwe's disease was an acute type of the same disease process.

CLINICAL FINDINGS

All the clinical signs are dependent on the location of the granulomatous masses and may be extremely variable. The involvement can differ between the extremes of a single bone lesion to generalized bone and soft tissue involvement. Early investigators mentioned that the triad of "skull defects, exophthalmos, and diabetes insipidus" were necessary for a diagnosis of Hand-Schüller-Christian's syndrome. Later it was found that any combination of these may be present and not infrequently all three so-called "essentials for diagnosis" were absent.

Headaches and localized areas of scalp tenderness are two of the more common findings. Defects in the mandible associated with gingivitis and loosening of the teeth are often present. Dalitsch[5] mentioned the frequency of oral lesions as a late manifestation of this disease. It has been noted that cutaneous lesions may occur rather frequently.[20] Occasionally a lymphadenopath may be the initial finding.[9,19] Enlargement of the liver and spleen has been reported.

It has been generally agreed that when diabetes insipidus is present it is a result of granulomatous infiltration of the hypophysis and tuber cinereum. Rowland[28] reported that with involvement of the pituitary gland, destructive changes in the sella were found in less than one-third of the cases. In younger individuals, signs of hypopituitarism (diabetes insipidus, dwarfism and adiposogenital dystrophy) are not an uncommon finding.

In those cases where there is considerable pulmonary involvement, the main complaints may be those of weakness, loss of weight, coughing and chest pain. In a recent report Currens and Popp[4] stated that pulmonary fibrosis is rarely associated with these cases but other authors have reported that it occurs rather frequently.[2,3,23,27,29]

There have been a number of cases where the initial finding, usually diabetes or a solitary bone lesion, has been present for many years prior to the development of generalized involvement. Davison[7] reported a case of a male, aged twenty-seven, whose complaints started at the age of twenty-two with pain and falling out of teeth. Diabetes insipidus developed at the age of twenty-five and neurological symptoms at the age of twenty-eight. The patient died of a pulmonary infection at the age of thirty. Dauksys[6] reported a case of a white male, aged thirty-seven, who had had a polyuria since the age of twenty-one. Hilton and Eden[15] report a case of xanthomatosis in which diabetes insipidus persisted for six years prior to the development of defects in the skull, femur and mandible.

Xanthomatous infiltration may simulate a mastoiditis. Exophthalmos, when present, is due to involvement of the bony orbits and not to increased intracranial pressure. The exophthalmos may be unilateral. Available literature shows a frequency of approximately 2 to 1 in males but does not reveal any apparent racial tendency.

For a long time xanthomatosis was though to be primarily a disease of the first decade but this is not a disease confined to childhood. Recently more cases in adults have been reported. Spontaneous remissions may occur in both the single and multiple lesions.[11,13,25,33] Disappearance of untreated pulmonary infiltration has never been observed.

LABORATORY FINDINGS

A review of the literature fails to show

any constancy in the laboratory findings that might be of value in diagnosing this group of diseases. Leukocytosis has been reported in a number of cases. An increase in the blood cholesterol level has been given considerable significance by some authors but numerous cases have been reported where the blood cholesterol values remained essentially within normal limits. Dauksys[6] in a rather detailed review of the literature found that 50 per cent of the reported cholesterols were above 230 mg. per 100 cc. of blood. The serum calcium, phosphorus, total protein, albumin-globulin ratio and phosphatase have shown no significant variations. A moderate eosinophilia has occasionally been reported. Smears and cultures from the lesions have failed to demonstrate the presence of a causative organism. Lane and Smith[20] reported that there were variations of lipoid content in different lesions in the same patient.

Most investigators agree that there may be considerable variation in the histopathology of these granulomatous lesions. The histopathology of Hand-Schüller-Christian's disease, eosinophilic granuloma and Letterer-Siewe's disease may be so identical that differentiation is impossible.[12,13] The granuloma may resemble a foreign body giant cell tumor or may exhibit the so-called typical xanthoma cells. Eosinophilic infiltration may be the predominant finding. Some authors[2,20] believe that the "foam cells" are present in the early stages of the lesion and disappear during the healing phase. Green and Farber described the appearance of "foam cells" as being associated with a late stage of this process. Letterer[21] stated that the "cholesterol infiltration merely represents a characteristic associated feature of the granulomatosis."

In a survey of the literature, Gross and Jacox[13] analyzed 84 reported cases of Hand-Schüller-Christian's disease and found that in 26 instances neither the presence nor absence of "foam cells" was mentioned. In 9 cases, autopsy and biopsy material showed no "foam cells." Eosinophilic infiltration was noted in 29 of the 84 cases. In 45 cases in which the blood cholesterol level was indicated, 23 had a level above 200 mg. per 100 cc. of blood.

ROENTGENOLOGICAL FINDINGS

The bone defects are not due to a disturbance of the calcium metabolism but to pressure from the granulomatous masses. Healing of the bone lesions occurs by newly formed spongiosa with occasional osteoid or cartilaginous tissue.[33] Bass[1] mentioned that eosinophilic granuloma is an expanding lesion of bone and felt that this was a distinctive characteristic of eosinophilic granuloma as compared with Hand-Schüller-Christian's disease. Green and Farber[11] reported that solitary granuloma of bone does not expand the cortex and shows minimal reactive changes in the bone except in the healing phase. Rowland,[28] Teperson,[33] Otani and Ehrlich,[24] Freund and Ripps,[9] all mention that thickening of the bone is rare in the acute form and usually occurs only in the adult or chronic form.

In early skull lesions, if two layers are involved, the defects have blurred margins and are moth-eaten in appearance. Large defects involving three layers are sharply delimited and geographic in appearance.[33] However, even with involvement of all layers the margins have an indefinite outline in the healing phase. The roentgenological appearance of the defects of Hand-Schüller-Christian's disease are similar to those found in the so-called eosinophilic granuloma or solitary granuloma of bone. Pathological fracture of a femur has been reported.[23] Lesions in the femur are not the clear-cut defects seen in the skull and resemble chronic osteomyelitis. A moderate bone reaction may be present.[15] Most of the reported skeletal defects have been in the skull, pelvis, femora, and ribs. Pulmonary involvement is not infrequent and is usually spoken of as a generalized fibrosis. Nearly all of the fatal cases have shown extensive involvement of the lungs.[23,27] In chronic cases, the pathology is largely a fibrosis but in the acute forms, it is mainly a soft

granulomatous infiltration. In the healing stage of these lesions, the appearance of the lungs may suggest pneumoconiosis. In the early phase, diffuse soft infiltration may be comparable to a generalized tuberculosis or a fungus infection. The roentgen appearance of the chest can be that of numerous small emphysematous blebs resulting from an escape of air into the interstitial tissues of the lungs secondary to granulomatous destruction of the alvolar walls.[8,20] Xanthomatous involvement of the lungs has never been observed alone or in cases of solitary lesions of bone.[34] Currens and Popp[4] report that pulmonary fibrosis has rarely been seen in connection with xanthomatosis. This is contrary to the reports of other investigators.[2,3,6,8,9,20,23,29,34]

DIFFERENTIAL DIAGNOSIS

The distribution of bone lesions is similar to that found in multiple myeloma and have frequently been mistaken for such. The lesions in the long bones, usually the femora, are not as sharply demarcated as in the skull and may be mistaken for chronic osteomyelitis. The skull defects must be differentiated from cholesteatoma, osteoporosis circumscripta, tuberculous osteomyelitis, syphilitic osteomyelitis, metastatic carcinoma and multiple myeloma. In some instances, an osteolytic lesion of the mandible is the only roentgen finding and may represent the initial bone lesion. A similar picture could be produced from a localized osteomyelitis, secondary to a root abscess or an infected cyst. History of pain and discharge from the ears may simulate a mastoiditis.

Clinical findings of a hypopituitarism may be entirely due to granulomatous invasion of the hypophysis and tuber cinereum. Cases which show a lymphadenopathy can be confused with Hodgkin's disease or tuberculosis. With massive granulomatous replacement of the bone marrow, the clinical picture is that of a severe aplastic anemia.[14,23] Pneumoconiosis, tuberculosis and fungus infections can produce a roentgen appearance similar to various phases of a reticulo-endothelial hyperplasia of the lungs.

TREATMENT

The early treatment of the Hand-Schüller-Christian's syndrome consisted of the use of a pituitary solution which apparently relieved the diabetes insipidus during the use of this drug. In addition, these patients were usually put on a low fat diet and, in some instances, desiccated thyroid. The results were not particularly gratifying and in 1930, Sosman[30] reported the beneficial use of deep roentgen therapy on skull defects. This was the beginning of what is now the accepted form of treatment for this group of diseases. Some investigators[26,31] have reported that the filling in of the defects following roentgen treatment requires a much longer time in the chronic or adult form. Improvement in the bone lesions has been noted as early as four weeks following treatment but in some instances was not complete until eighteen months following therapy. Very few cases have been reported where there has not been a favorable response to deep roentgen therapy. The recently described solitary lesion of bone has also responded well to roentgen therapy.[12] Most authors reporting the use of deep roentgen therapy state that there has been a rapid symptomatic response. In some instances the lesions have been treated by curettage. Some of these have shown no improvement following the operation and recurrences have occurred. Teperson[33] reports a case of a cranial defect above the right orbit which was surgically excised and recurred four months after operation. One and one-half years later there was generalized bony involvement. Roentgen treatment was given to the parathyroids but the defects continued to increase in size. Deep roentgen therapy was subsequently given to the skull and ilium and the cranial defects began to recede at the end of four weeks.

Reports of the treatment of pulmonary lesions are rare. Kartagener and Fischer[17] were of the opinion that irradiation of the

lungs made the fibrosis worse. Currens and Popp[4] reported a case treated with a total dose of 270 r at 130 kv. with marked improvement in the bone lesions. This patient exhibited pulmonary fibrosis which was treated with deep roentgen therapy. Slight improvement of the treated portions was noted. One side of the chest was treated and the opposite side was used as a control.

Jones[16] reported a single case which showed reossification in one to four months following roentgen therapy. He was of the opinion that the longer the lesions are present prior to treatment, the slower the reossification. Wortis, Wolf and Dyke[36] reported 2 cases treated with deep roentgen therapy using small doses (300 r) with regression of the lesions in six weeks. Kellogg[18] reports a case of a single lesion in the skull treated with roentgen therapy, dosage not stated, with almost complete healing in one and one-half years.

Irradiation of pituitary gland to control the diabetes has met with varying degrees of success. Obviously little improvement can be anticipated where the involvement is no longer in the granulomatous stage but has gone on to fibrosis.

It is noteworthy that many of the reports in the literature do not satisfactorily describe the amount or type of roentgen therapy administered.

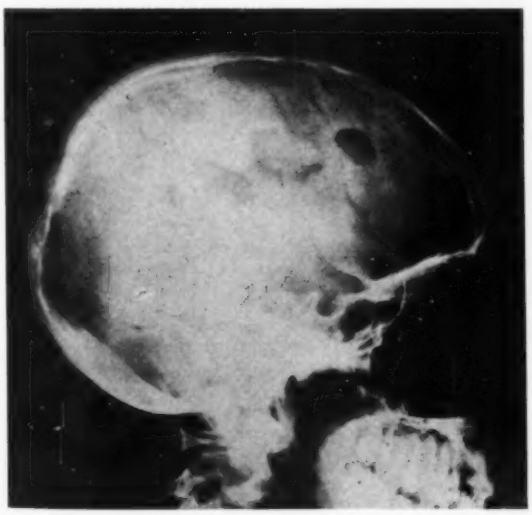

Fig. 1. Case 1. Lateral projection of the skull demonstrating multiple irregular areas of bone destruction particularly in the left parietal and occipital bones.

Fig. 2. Case 1. Skull examination seventeen weeks after completion of roentgen therapy showing considerable filling in of the bone defects.

REPORT OF CASES

Case 1. White, male, aged twenty-four, was admitted to Letterman General Hospital, May 4, 1944, complaining of polydipsia and polyuria which had existed since February, 1943. He had lost approximately 12 pounds in weight.

Past history disclosed an appendectomy in 1924 at the age of four years, and submucous resection in December, 1943. Patient sustained a fracture of the left little finger in 1925. No further history of illness or accident.

Patient entered military service on February 18, 1941. At that time he states that he was in good health with no complaints. While on a routine flight in January, 1943, the plane dropped about 200 feet and the patient struck his head on the canopy. He was not unconscious, but a headache was noted which lasted for four days. It was following this headache that an increase in thirst was first noted. The patient also noted a gradual loss of weight during this time.

In February, 1943, he was hospitalized and a routine roentgenogram of the chest revealed a pneumonitis of the left lung. Patient had no pulmonary complaints. He stated that during exercise periods, he seemed to "burn up" and could not perspire and that he passed out three times from heat exhaustion. The polydipsia

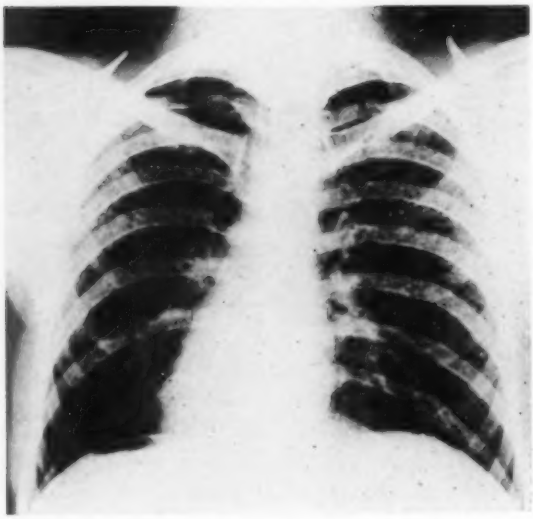

FIG. 3. Case 1. Posteroanterior projection of chest showing extensive fibrosis throughout both lungs, slightly more marked on the right.

and polyuria persisted but other than this the patient was asymptomatic.

One year later the patient was again hospitalized for a persistence of the pulmonary infiltration and was later transferred to Letterman General Hospital.

On admission the patient was a well developed and well nourished white male showing no abnormal physical findings with the exception of several small areas of scalp tenderness in the left parietal and occipital regions.

A complete roentgenological survey revealed the following findings: At the junction of the proximal and middle thirds of the left femur, there were about 15 small indefinite and irregular areas of decreased density, none of which exceeded 5 mm. in diameter and were associated with a moderate increase in the thickness and density of the cortex. There was a resultant increase in the diameter of the femur in this area. A roentgenogram of the chest showed extensive soft infiltration and fibrosis throughout both lungs, slightly more marked on the right. There were no other significant findings. Roentgenograms of the skull showed multiple irregular areas of bone destruction most of which were located in the left half of the skull and in the occipital region. One spherical area of bone destruction measuring 2 cm. in its greatest diameter was located in the right frontal bone. This defect was much smoother in outline, as compared with the other skull lesions. The defects in the left parietal region were markedly irregular in outline and had less definite margins. The areas of bone destruction in the occipital region were the least prominent. There was no bone reaction about any of the skull defects. The sella was normal in appearance.

Laboratory findings were as follows: Urinalyses showed a persistently low specific gravity varying between 1.000 and 1.007 and repeated examinations for Bence-Jones protein were negative. Blood chemistry studies. Serum protein 7.2 mg.; serum albumin 3.4 mg.; serum phosphorus 4.1 mg.; serum calcium 10.7 mg.; alkaline phosphatase 2.1 Bodansky units; the cholesterol level showed very little variation, 254 to 259 mg.; cholesterol esters varied between 200 and 210 mg. Blood counts remained within normal limits.

On May 15, 1944, a biopsy of skull lesions was done under local procaine infiltration anesthesia. An incision was made in the occipital region just above the external occipital protuberance and about in the midline. A grayish, granular appearing material was seen extruding from the defect in the skull. This material was curetted away and it was found that both tables of the skull had been involved and the defect went through to the dura.

Pathological Report. The specimen consists of several small hemorrhagic, yellowish and brownish fragments of tissue.

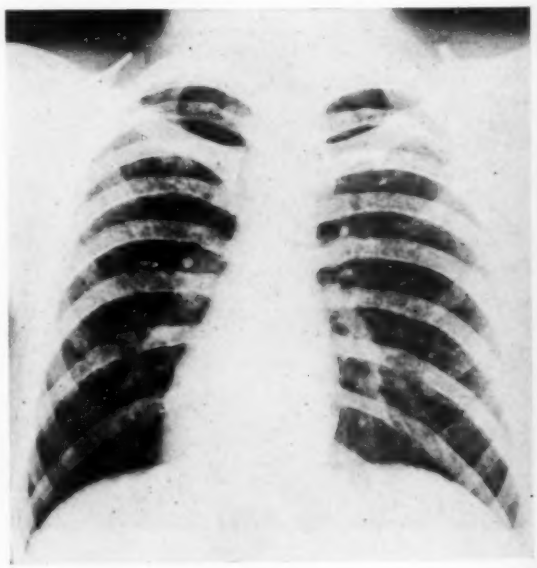

FIG. 4. Case 1. Chest examination twenty and one-half weeks later shows very slight improvement.

Microscopic: The specimen is composed of inflammatory and fibrotic granulation tissue. The cellular infiltrate consists of two chief types of cells, one an eosinophile and the other a single or multinucleated histiocyte, occurring focally, diffusely and occasionally in spaces. The eosinophiles are extremely numerous and of the mature type. The histiocytes are single and multinucleated. The nuclei are small and large, irregular in outline, vesicular, often indented or folded and contain a well defined nucleolus. There are sometimes as many as twelve or more nuclei scattered about the periphery or concentrated in the center of the cell. The cytoplasm stains deeply and shows considerable phagocytosed material including stainable lipoids; pigment and cellular debris, particularly eosinophiles in part or in whole. The granulation tissue is fairly well preserved but shows areas of hemorrhage and coagulation necrosis. The vacuolar fatty changes are most pronounced in the degenerated areas. There are no large sheets of viable xanthomatous cells. The fibroblasts of the stroma are mature. The granulation tissue is rich in capillaries. There are a few infiltrated small lymphocytes. There is no evidence of bone. Impression: Chronic granulomatous lesions of skull with numerous eosinophiles and single and multinucleated macrophages containing moderate amounts of stainable lipoid.

Fig. 5. Case 1. Multiple small defects in the left femur with thickening of the cortex and expansion of the bone. There was no demonstrable change subsequent to roentgen therapy.

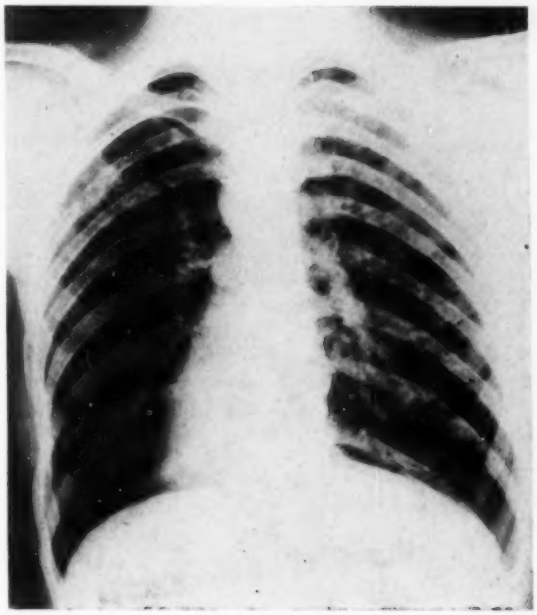

Fig. 6. Case 11. Posteroanterior projection of the chest shows a diffuse soft infiltration in both lungs and an area of bone destruction in the posterior portion of the left fifth rib.

Case 11. White, male, aged twenty-seven, was admitted to Letterman General Hospital on April 10, 1944, complaining of pains in the left chest aggravated by deep breathing and a tender spot just to the right of the symphysis of the mandible. Patient also complained of some indefinite pain in the region of the right hip.

Past history disclosed no previous illness with the exception of an attack of the mumps in childhood.

Patient entered military service on October 3, 1942. While enroute to the Southwest Pacific Area in May, 1943, he fell and injured his right hip. There was no particular discomfort until about three weeks later when he noticed the onset of sharp pains in the right hip, particularly while walking. At rest he noticed a constant aching in that region. There were no

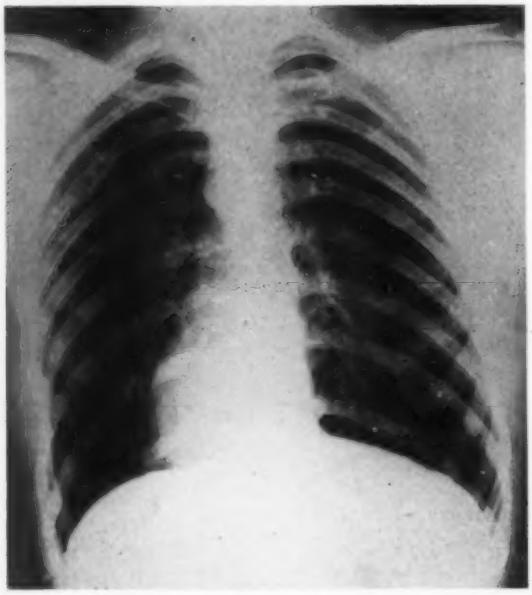

Fig. 7. Case 11. Chest examination seventeen and one-half weeks later showing marked clearing of the chest. Roentgenogram taken sixteen weeks following treatment to the right chest and four and one-half weeks following treatment to the left chest.

fevers, chills or involvement of other joints. During August, 1943, he was hospitalized for three weeks because of this discomfort. In October, 1943, he was hospitalized again because of malaria, having had three serious paroxysms. During November, 1943, he started complaining of slight sticking pains in the left chest aggravated by deep breathing. One month later he noted a tender spot just to the right of the symphysis of the mandible. Roentgen evidence of a bilateral pneumonitis resulted in his admission to a hospital. During his six weeks of hospitalization, he began to complain of mild pain and looseness of the right lower teeth. Roentgenogram of the mandible disclosed an osteolytic process in this area and the six lower anterior teeth were removed.

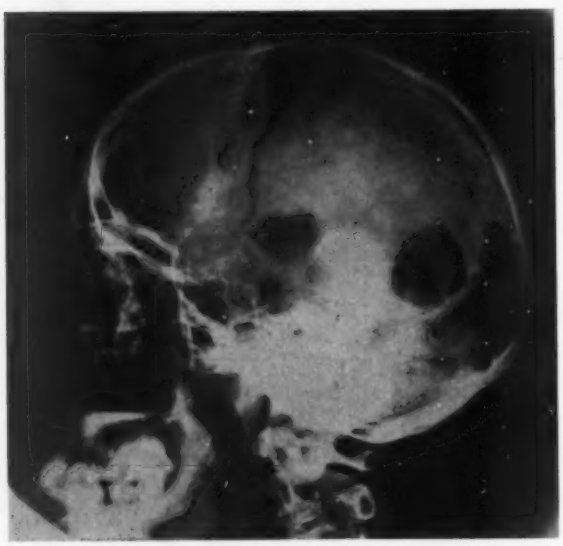

Fig. 8. Case 11. Lateral projection of the sklulsh ows multiple sharply circumscribed areas of bone destruction in the right parietal and occipital bones.

On February 8, 1944, he was admitted to a general hospital where the following findings were obtained: (1) a mild evening fever was present throughout his eight weeks of hospitalization; (2) the liver was found to be enlarged; (3) roentgen evidence of localized osteolytic processes in the fifth left rib posteriorly, numerous areas in the skull, the anterior portion of the right side of the mandible and the pelvis. A roentgenogram of the chest showed extensive soft infiltration in both lungs which was thought to be a moderately advanced bilateral pulmonary tuberculosis. Specimens were obtained from the left fifth rib and the skull.

Fig. 9. Case 11. Skull examination twenty-three and one-half weeks later with an almost complete filling in of one of the defects and more indefinite margins to the remaining defects. A new area of bone destruction is noted in the left frontal bone.

Laboratory findings during this time were as follows: Bence-Jones protein, serum calcium,

repeated blood cultures and repeated smears and cultures of the sputum for tuberculosis and fungi were negative. The only significant laboratory finding was a high blood cholesterol which varied between 235 and 288 mg. A specimen of sternal marrow was obtained and showed no significant findings. Smears and cultures from the operative areas were entirely negative.

Pathological Report. The specimen consists of many irregular fragments of soft grayish-white tissue.

Microscopic: For the most part, the cells are peculiarly lobulated, large mononuclear type,

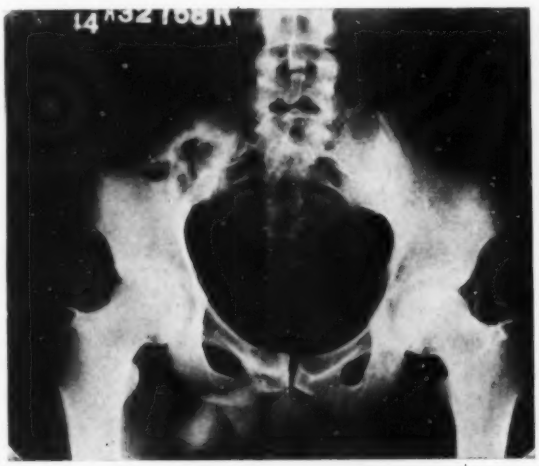

Fig. 10. Case II. Irregular areas of bone destruction in the right sacroiliac region.

a few of which contain nucleoli and some of which resemble epithelioid cells. There are a number of phagocytes containing erythrocytes, brown pigment probably hemosiderin, and lipoid droplets. Numerous eosinophiles, both diffuse and focal in location, are scattered throughout. There are a few small giant cells with two or three nuclei, many of which contain phagocytosed material. A few scattered mitotic figures are seen. Necrosis and hemorrhage are noted. Scarring and fibroblastic reaction is minimal. Impression: eosinophilic granuloma.

On admission to Letterman General Hospital, the patient showed evidence of a moderate loss of weight and localized areas of tenderness in the anterior portion of the right side of the mandible, the left fifth rib posteriorly and the right parietal and occipital areas. Liver and spleen were not enlarged.

Fig. 11. Case II. Recheck roentgenogram shows almost complete healing of the defects in the right sacrum and ilium.

Further laboratory studies revealed a normal sedimentation rate; blood cholesterol levels ranging between 250 and 256 mg; repeated urinalyses and blood counts to be within normal limits and a negative serological test for coccidioidal infection.

Roentgenological studies showed the following findings: There was extensive soft patchy infiltration throughout the upper two-thirds of both lungs. A cyst-like area of bone destruction was present in the posterior portion of the left

Fig. 12. Case II. Irregular area of bone destruction in the anterior portion of the right mandible.

fifth rib and measured approximately 3 cm. in its greatest diameter. There was moderate expansion of the rib in this area. Many of the other ribs exhibited small irregular indefinite defects. The distal half of the right wing of the sacrum and the adjacent portion of the ileum contained multiple irregular areas of bone destruction, the margins of which showed no bone reaction. There were several small areas of decreased density in the right pubis which probably represented early changes of the same process. Multiple sharply delimited areas of bone destruction involved the right parietal, temporal and occipital bones. The largest of these defects measured 4 cm. in diameter. Roentgenogram of the right mandible disclosed a single large defect just anterior to the mental foramen.

A specimen was again obtained from the occipital region of the skull with the following microscopic findings: Sections show a moderately dense fibrous background which, in some regions, is densely infiltrated with many different types of cells. There is a distinct predominance of eosinophilic leukocytes in some regions. In other places, the lymphocytes stand out sharply. Associated with these two types of cells are sheets of large mononuclear cells that have a prominent, somewhat vesicular nucleus in which there is a large basophilic nucleolus. These phagocytic cells are occasionally multinucleated. Sometimes, they have a vacuolated cytoplasm. Pigment may be present in the cytoplasm. An occasional mitotic figure is noted. An occasional large blood vessel is present but there is nothing unusual about the general vascular network. Cultures prepared from the material at the time of surgery showed no growth in any of the media inoculated. Routine typhoid-paratyphoid agglutinations were set up with the patient's serum and were negative. In addition, several *Salmonella* antigens were used, particularly strains of typhimurium and these were negative. Diagnosis: Eosinophilic granuloma of bone.

TREATMENT

Case I. In view of the marked elevation of the fluid intake and output, it was decided to first irradiate the pituitary gland. Daily treatments were given on four successive days using right and left 7 by 7 cm. fields. Both fields were treated daily and received 100 r with the following factors: 200 kv.; 0.5 mm. copper and 1 mm. aluminum added infiltration; half-value layer 0.9 mm. copper; 50 cm. skin-target distance and 28.5 r per minute in air. A total dose of 400 r was delivered to each field. Treatments were begun on May 20, 1944.

A 7 by 7 cm. field was directed to the right side of the skull and a 10 by 10 cm. field to the occipital region. These areas received 100 r every other day for a total of 400 r to each field. Treatments were begun on May 25, 1944.

An anterior and a posterior field, each measuring 15 by 15 cm. were directed to the involved area in the left femur. Each area received 200 r on alternate days for a total of 600 r to each field. This series of treatment was instituted on May 31, 1944.

A series of deep roentgen therapy to the right chest was instituted on June 1, 1944, using two anterior and two posterior fields all of which measured 15 by 15 cm. A single field was treated daily and received 200 r per treatment. Each area received a total of 600 r. The left side of the chest was then treated in a similar manner beginning August 7, 1944, and each of these fields also received a total of 600 r. The same physical factors were used for treatment of all areas.

All roentgen dosages refer to air measurements.

Case II. Two 7 by 7 cm. fields over the anterior portion of the right mandible and the right temporo-parietal region and a 15 by 15 cm. occipital field were treated every other day with the same factors as in Case 1. The three areas received 100 r every other day for a total of 400 r to each field. Treatments were instituted on May 12, 1944.

A single 15 by 15 cm. posterior field was used to treat the destructive lesion in the right sacroiliac region. Daily treatments of 100 r were given for a total of 400 r to this field. Treatments were begun on May 26, 1944.

On May 30, 1944, a series of deep roentgen therapy to the right chest was instituted using two anterior and two posterior fields, each of which measured 15 by 15 cm. A single field was treated daily and received 200 r per treatment. Each field received a total dose of 600 r.

A second series of treatments to the right sacroiliac region were instituted on June 13, 1944, and the same dosage repeated.

On August 7, 1944, a series of deep therapy treatments to the left side of the chest were begun and treatments given in exactly the same manner as on the right side of the chest.

On September 6, 1944, a single 7 by 7 cm.

portal was directed to the new lesion that developed in the superior aspect of the left frontal bone. Daily treatments of 100 r were given for a total of 300 r to this area.

All roentgen dosages refer to measurements in air.

RESULTS OF THERAPY

Case I. Following a series of deep roentgen therapy to the pituitary gland, there was a rather prompt and marked reduction in the fluid intake and output so that at the end of one week, patient's average intake and output was 4,500 cc. per twenty-four hours as compared with 10,000 to 11,000 cc. intake and output at time of admission. Tenderness and aching of the bones rapidly disappeared while treatments were being administered to the areas of destruction. There was no apparent change in the appearance of the lesion in the proximal half of the left femur. Follow-up roentgenograms of the skull showed a marked filling in of all of the bone defects. The margins of these defects are now difficult to trace. The roentgenogram of the chest showed very slight improvement. There was some regression of the small patchy areas of soft infiltration but the extensive areas of fibrosis were relatively unchanged in appearance.

Case II. There has been a marked clearing of the chest with a minimal amount of residual fibrosis. The defect in the left fifth rib was slightly larger in size but this was attributed to the fact that the left side of the chest was not treated until two months after roentgen therapy had been given to the right side of the chest. A roentgenogram of the pelvis showed a marked filling in of the bone defects which now exhibit a small zone of osteosclerosis about their margins. Roentgenograms of the skull demonstrated considerable filling in of the defect in the right temporal bone and less sharply demarcated borders of the remaining defects. A new area of bone destruction measuring 1.5 cm. in diameter was noted in the posterior portion of the superior aspect of the left frontal bone. This patient also exhibited early relief of pain and tenderness in the treated areas.

SUMMARY AND CONCLUSIONS

The separation of Hand-Schüller-Christian's disease, eosinophilic granuloma or solitary granuloma of bone and Letterer-Siwe's disease into specific disease entities is not valid on the basis of the evidence at hand.

There are insufficient data to support the claim of a lipoid metabolic disorder as the primary causative factor. There are no pathological or roentgenological findings that warrant classifying these syndromes as individual diseases. It is felt that all these processes are variants of a hyperplastic reaction of the reticulo-endothelial system and can be properly grouped under the term reticulo-endotheliosis. Eosinophilic granuloma or solitary granuloma of bone represents a localized or focal hyperplasia of the reticulo-endothelial system.

The stage of the disease process in the hypophysis and tuber cinereum will determine the response of the diabetes insipidus to roentgen therapy. Little or no improvement will occur if the infiltration is in the stage of fibrosis.

The pulmonary pathology is comparable to that found in the bones which, in its early stages, is a granulomatous process and in the healing phase is almost entirely fibrosis. Pulmonary involvement in the early phase responds to deep roentgen therapy but lesions that have gone on to fibrosis show very little change.

Satisfactory response of the bone, pituitary and pulmonary lesions can be obtained with relatively small doses of roentgen radiation. In the two cases reported, 600 r, measured in air, to any one field was exceeded on only one occasion. None of the skull lesions received more than 400 r, measured in air, through any one field.

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Vol. 56, No. 3

ROENTGENOLOGICAL EXAMINATION OF THE POWER OF RESISTANCE OF THE TRACHEAL WALL

AN IMPORTANT SIGN IN TREATMENT OF TRACHEAL STENOSIS

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THE trachea is a hollow cylinder filled with air embedded in organs of greater density. Therefore it must be visible in the roentgenogram. A roentgen examination based on the representation of the trachea in two positions, perpendicular to each other —in anteroposterior and lateral positions— must give a true picture of the changes in position and shape of the trachea. The roentgen examination of the trachea in these two positions makes it possible to recognize whether the trachea has undergone any change in its position and whether a stenosis is present. These facts are of great importance when considering pathology and therapy of the case in question.

In examining the trachea in the lateral position the patient lies on his side on the table, his shoulders bent backward as far as possible. The patient is fixed in this position. His head is supported at the natural level by sand bags. The central ray is projected to the clavicle nearest the film, aiming at the center of the film.

In addition to roentgenography, roentgenoscopy plays an important part. In roentgenoscopy the patient should turn slowly. In this way roentgenoscopy will show the trachea most clearly at the moment when the central ray passes the longest diameter of the tracheal stenosis. Thus roentgenoscopy (complementary to roentgenography) allows important conclusions about the kind of the tracheal stenosis and particularly in cases in which the pressure on the trachea takes place in an oblique direction.

By means of the roentgen examination we can recognize displacements, deviations and stenoses of the trachea in a much more simple and exact way than by laryngological methods. On the other hand, the roentgenological examination will not inform us about other questions (condition of the mucous membrane, disturbances in innervation, etc.) which can be ascertained easily by laryngological examination.

Displacements and stenoses of the trachea are most frequently observed in patients with goiter. An objective determination of the question whether difficulties in breathing are due to pressure of the goiter on the trachea is important; because it is well known that dyspnea in patients with goiter is not necessarily caused by stenosis of the trachea but may be due to a pathological condition of other organs, particularly of the heart and lungs. The operative removal of a goiter in a patient where the difficulties in breathing have been erroneously attributed to a tracheal stenosis would do great damage to the patient and would be a serious mistake.

A well known fact is the frequent and striking disproportion between the degree of the tracheal stenosis and the degree of the dyspnea. Especially patients with slowly growing goiters and gradually increasing pressure on the trachea will become accustomed to the difficulties in respiration to such an extent that they will scarcely become aware of any serious trouble. No doubt these patients are in constant danger as a slight swelling of the mucous membrane in the area of the stenosis may produce serious difficulties in breathing and suffocation.

The roentgen examination made according to the above mentioned technique offers without any difficulty an objective judgment on the condition of the trachea. At the same time it will give us an explanation about a possible presence of an intrathoracic goiter, about the condition of the heart and the lungs. Roentgenoscopy, con-

secutive to roentgenography, will show whether or not the intrathoracic portion of the goiter rises in swallowing and coughing. This differentiation is of great importance as indication for the kind of treatment. A lack of mobility reveals presence of adhesions with the neighboring tissues which may make an operative removal of the goiter very difficult (danger of gas embolism, asphyxia, mediastinal emphysema, etc.).

With the statement of the kind of displacement and change in shape of the trachea, the efficiency of the roentgen examination in pathological conditions of the trachea is by no means completed. In addition it further offers a *knowledge of the condition of the tracheal wall.* It allows a critical examination of the *power of resistance and firmness of the cartilaginous rings of the trachea.* The power of resistance of the tracheal wall is very frequently weakened by a long lasting pressure exerted by the goiter. The firmness of the cartilaginous rings of the trachea, their power of resistance may decrease by the pressure of a long existing goiter causing a great danger for the patient. The cartilaginous tissue of the tracheal rings may in some places partly or completely disappear. Thus the dreaded and dangerous pathological feature of a *malacia of the trachea* may develop. This softening of the cartilaginous rings of the trachea may cause sudden death by suffocation due to collapse of the trachea.

Malacia of the trachea is not infrequently observed in goiters of adults which have existed for many years, particularly in hard fibrotic goiters, sometimes also in recent goiters of young people. Very often malacia of the trachea is also observed in malignant goiters.

The knowledge of the condition of the wall of the trachea in patients with goiter is of the greatest importance as in this way we learn to judge the degree of danger to the patient arising by the tightening of the trachea by the goiter.

Between normally preserved cartilaginous tracheal rings and pronounced malacia all transitional stages of softening of the tracheal wall may be observed. The roentgen examination easily demonstrates the serious and dangerous pathological features of malacia which mean an absolute indication for operative removal of the goiter.

The softening and weakening of the tracheal rings is easily diagnosed by a change in width of the tracheal lumen in intratracheal increase and decrease of air pressure[1,2] *Malacia of the trachea in the area of the stenosis can be recognized without any difficulty by great enlargement of the tracheal lumen in increased intratracheal air pressure and by a very marked narrowing in decreased intratracheal air pressure.*

For an increase in intratracheal air pressure the experiment of Valsalva is used (deep inspiration, closure of nose and mouth, and attempt to exhale); for decrease in intratracheal air pressure the experiment of Müller is employed (complete exhalation, closure of nose and mouth and attempt to inhale). The str king changes in the width of the tracheal lumen under the influence of these two experiments are easily explained by the decreased power of resistance of the tracheal wall in the area of malacia. In increased intratracheal air pressure this diminished power of resistance will cause an abnormal protrusion; in decreased intratracheal air pressure it will cause narrowing of the tracheal lumen in the area of malacia or a complete collapse of the trachea due to a sucking effect.

On the other hand, the changes in shape of the tracheal stenosis in normal power of resistance of the cartilaginous rings of the trachea are very small, equal and concentric on both sides; whereas in malacia, changes in shape of the trachea usually involve one wall only. These changes are not only very marked but also unequal and eccentric.

It would be too demanding on the doctor's time, especially in large hospitals, to have to explain to every patient with a

goiter the experiments of Valsalva and Müller in examining the trachea. For orientation in roentgenoscopy it appears sufficient instead of the experiment of Valsalva to have the patient cough in order to increase the intratracheal air pressure and instead of the experiment of Müller to have him sniffle in order to decrease the intratracheal air pressure.

Before examination of the trachea for changes in width of its lumen under changed conditions of air pressure it is advisable to slowly rotate the patient during roentgenoscopy until the trachea is most clearly visible; that is, that position in which the central ray passes the longest diameter of the tracheal stenosis. In serious cases of malacia we may in this manner even see roentgenoscopically a respiratory fluttering of the tracheal wall.

The tracheoscopical examination recognizes the pathological feature of malacia of the trachea by haziness of the design and narrowing of the tracheal rings, by decrease in consistency of the mucous membrane, possibly by a respiratory fluttering of the tracheal wall. However, this tracheoscopical diagnosis of malacia of the tracheal wall will be possible only in advanced cases and often then only supposedly.

A systematic roentgenological examination of the power of resistance of the cartilaginous rings against intratracheal changes in air pressure will be very useful for indicating the kind of treatment of patients with goiter. It is superfluous to state that the evidence of a pronounced malacia represents a strict indication for operation. But also evidence of a merely diminished power of resistance of the cartilaginous rings of the trachea will make an operation advisable in cases not complicated by serious pathological conditions of heart and lungs.

It is important to *know of the presence of of a tracheal malacia before an operation because of danger of an asphyctic insult* during or shortly after the operative intervention. Such a serious event may require an immediate tracheotomy. It is hardly necessary to mention to what extent the tracheotomy may hinder the healing of the wound. Therefore the operation in proved malacia must be performed under special precautions (a possible introduction of a tracheoscope) and according to definite methods (leaving of a coat of goiter tissue as a support around the area of tracheal malacia or fixation of the trachea by stitches) in order to avoid these untoward and extraordinarily dangerous incidents.

A malacia of the cartilaginous tracheal rings does not disappear after a goiter operation. This fact I was able to show by re-examining patients with malacia of the trachea several years after the operation. All these patients had no trouble at all after the goiter which had tightened the trachea had been removed. Stenosis of the tracheal lumen in malacia of the trachea disappears in the course of several months after the operation. Repeatedly instead of a former stenosis in the area of malacia a considerable dilatation of the trachea developed and persisted as evidenced by check examination later.

A roentgen examination of the trachea in patients with goiter reveals the type of its displacements, deviations and stenoses, and also the power of resistance of its wall. It also demonstrates the direction from which the goiter exerts the pressure. All these revelations are of great importance in a possible operation. The knowledge of the kind of pathological change of the trachea will possibly keep the surgeon from removing a lobe of a goiter, imposing by its size but not compressing the trachea and from leaving a small lobe which is the real cause of the stenosis.

The examination of the power of resistance of the cartilaginous tracheal rings in intratracheal changes of air pressure will prove its value for the indication of an operative or conservative treatment in those complicated cases of intrathoracic goiter attached by adhesions to the neighboring tissues and causing a stenosis of the trachea. This attachment to the adjacent

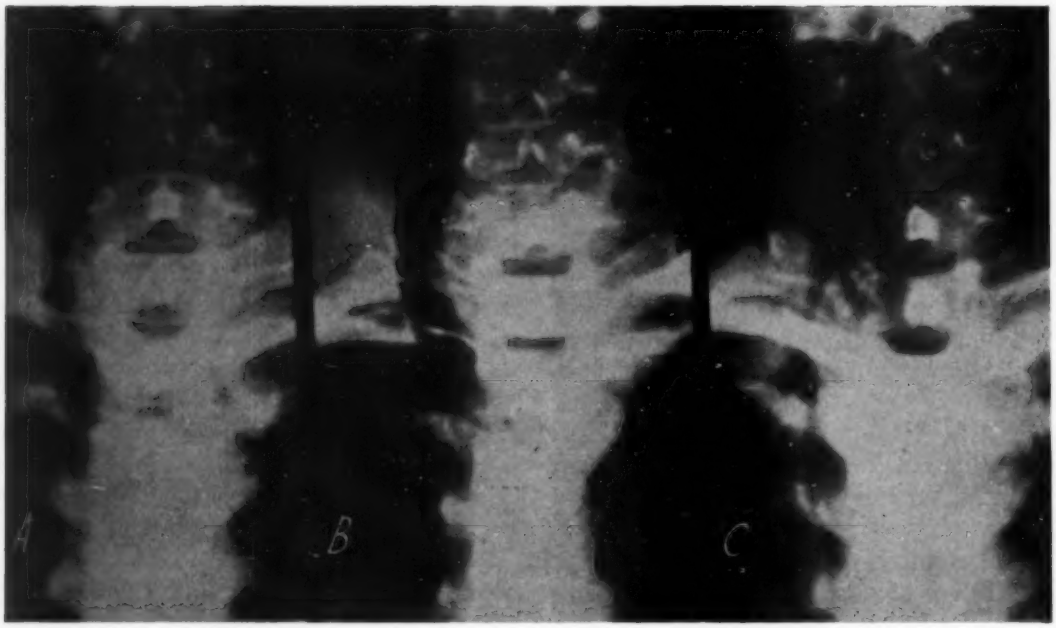

FIG. 1. Patient M. U. *A*, examination of goiter made with normal intratracheal air pressure (anteroposterior position). *B*, examination of same patient with increased intratracheal air pressure (experiment of Valsalva). The tracheal stenosis is considerably widened. *C*, examination with decreased intratracheal air pressure (experiment of Müller). The tracheal stenosis is considerably narrowed. Result: The power of resistance of the tracheal wall is diminished.

tissues can easily be shown roentgenoscopically by its immobility in swallowing and coughing. These are the cases which, if complicated by serious pathological changes of the heart, offer great difficulties for the determination as to whether an operative or conservative treatment is indicated.

In these difficult cases the knowledge of the quality of the power of resistance of the tracheal wall derived from the examination of the trachea under increased and decreased air pressure will facilitate the grave decision for the kind of treatment to be followed. The evidence of a weakened power of resistance of the tracheal wall, particularly in its intrathoracic part, will make an operation, though it may be dangerous, more advisable for the patient than a conservative treatment. It is superfluous to mention that the result also of the internal examination must be most carefully considered.

The roentgenograms reproduced show 2 cases of malacia of the trachea.

Figure 1 *A*, *B*, and *C* are of a patient, M. U., female, aged fifty-eight who suffered from a goiter for fifteen years, which caused difficult breathing in the last few months.

Figure 1*A*, the anteroposterior roentgenogram, shows a compression of the trachea from the right and left sides and its moderate displacement to the left (normal intratracheal air pressure).

Figure 1*B* is the same trachea under increased intratracheal air pressure (experiment of Valsalva). The lumen of the trachea widened in the area of the stenosis approximately three times the former width.

Figure 1*C* shows the same trachea under decreased air pressure (experiment of Müller). The lumen of the trachea is narrowed to about one-half its diameter under normal air pressure (Fig. 1*A*).

These changes in width of the tracheal lumen make it evident that the power of resistance of the wall of the cervical part of the trachea is diminished. The operation confirmed the roentgenological finding.

Figure 2*A*, *B* and *C* are the lateral roentgenograms of the trachea of a patient, I. G., female, aged sixty-five, with a *very severe*

malacia of the trachea. She suffered from a goiter for more than twenty years. In the last two years she had great difficulty in breathing. The anteroposterior roentgenogram showed no displacement of the trachea to the right or to the left. In the lateral roentgenogram (Fig. 2*A*) a marked displacement of the trachea backward was visible. At the same time the trachea was severely compressed by pressure exerted by the goiter from the front.

Figure 2*B* is the roentgenogram of the same trachea in increased intratracheal air pressure (experiment of Valsalva). Its lumen is widened very considerably, at least seven times, whereas under decreased intratracheal pressure of air (Fig. 2*C*) (experiment of Müller), a complete collapse of the trachea in the area of stenosis was observed.

These great changes in width of the lumen of the trachea are characteristic of a severe malacia. This finding also was fully confirmed by operation.

Not only in patients with goiter but also in a great number of other pathological conditions, displacements and stenoses of the trachea are observed. In some of them, especially mediastinal tumors, a malacia of the trachea may occur simultaneously.

SUMMARY

It is the purpose of the roentgen examination of the trachea, after establishment of type and extent of possible displacement and stenosis, to examine the power of resistance of the cartilaginous tracheal rings. In recent goiters of young people and in goiters of adults which have existed for many years as well as in malignant goiters and mediastinal tumors, not infrequently a softening and partial disappearance of the cartilaginous rings of the trachea takes place. This fact means a great danger for the patient and may cause sudden death by collapse of the trachea. Therefore so-called malacia of the trachea is an absolute indication for operation on the goiter.

It is important to know about tracheal malacia before operation because of the

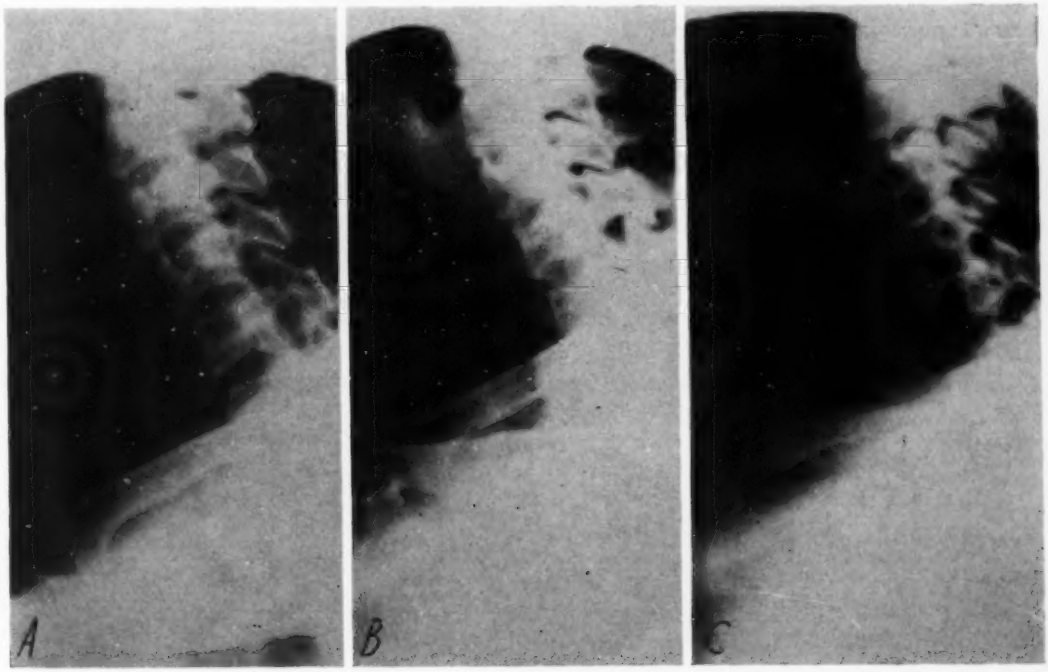

Fig. 2. Patient I. G. *A*, examination of goiter made with normal intratracheal air pressure (lateral position). *B*, examination of same patient with increased intratracheal air pressure (experiment of Valsalva). The tracheal stenosis is widened at least seven times. *C*, examination with decreased intratracheal air pressure (experiment of Müller). Complete collapse of the trachea in the area of the stenosis. Result: Severe malacia of the trachea.

danger of an asphyctic insult during or shortly after the operative intervention. Therefore the operation in proved malacia must be performed under special precautions, and the operative intervention must be modified according to definite methods. The roentgen examination of the trachea can prove without difficulty whether or not the cartilaginous tissue of the trachea is of normal resistance.

The following method of roentgen examination of the trachea in suspicious cases is recommended:

1. Examination of the trachea in anteroposterior and lateral positions in normal intratracheal air pressure.

2. Examination of the trachea in increased intratracheal air pressure (experiment of Valsalva: deep inspiration, closure of nose and mouth and attempt to exhale).

3. Examination of the trachea in decreased intratracheal air pressure (experiment of Müller: deep expiration, closure of nose and mouth and attempt to inhale).

If malacia of the trachea is present, there occurs in examination with increased intratracheal air pressure (experiment of Valsalva) a very marked dilatation of the tracheal stenosis in the area of malacia, and in examination with decreased intratracheal air pressure (experiment of Müller) a very marked narrowing or complete collapse of the stenosis in the area of malacia.

Before *roentgen treatment* of a goiter or of a mediastinal tumor it is important to determine, besides the degree of stenosis of the trachea, the power of resistance of its wall. If a malacia of the tracheal wall is found, roentgen treatment must be performed with greatest care and precaution. Only very small doses on many consecutive days should be applied; otherwise a sudden swelling of the pathological tissue due to an early reaction may cause a complete collapse of the weakened tracheal wall and sudden death by suffocation.

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A NEW MEDIUM FOR CYSTOURETHROGRAPHY*

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FOR a period of ten years we have been using cystourethrography as an aid in the diagnosis of lesions of the bladder, prostate, and urethra. This work has been done at the suggestion of and with the closest cooperation of Dr. R. M. LeComte, urologist to Georgetown University Hospital. Extensive articles by Flocks,[2] Crabtree and Brodney,[1] and others, have appeared in the urological literature. The only article dealing with this subject in the past ten years in radiological journals has been the recent one by Pereira[4] in this JOURNAL.

The medium which we first employed, that introduced by Flocks, was lipiodol and mucilage of acacia. Its disadvantage was that it was unstable and had to be made up freshly each time it was used. The next medium tried was skiodan in mucilage of acacia, manufactured by the Winthrop Chemical Company. This proved satisfactory, although the viscosity was not great enough. Since 1939 we have used a medium called Visco-rayopake, a product of Hoffmann-LaRoche Company. This is an aqueous solution with approximately 50 per cent organic iodine compound and 3 per cent polyvinyl alcohol. It fulfills all the necessary requirement of a good contrast medium for cystourethrography: namely, maximum opacity, minimum irritation, homogeneous nature, suitable viscosity, and it is not necessary to remove the dye from the bladder and urethra after instillation, as it is miscible with urine. This preparation has been used in all types of cases, including traumatic rupture of the urethra, and there have been no unusual reactions.

The following is a brief description of the technique employed. The only equipment necessary is a 30 cc. syringe with 5 cm. of soft rubber catheter firmly attached to the tip as an adapter.

A plain roentgenogram of the abdomen is taken first. The bladder is emptied of urine. The patient is placed in the right anterior oblique position; i.e., with the left hip slightly elevated by use of a sandbag under the left hip. The right thigh is flexed and the left extended. The tube is centered directly over the symphysis pubis and a technique making use of the Potter-Bucky diaphragm is employed. The operator then inserts the soft rubber catheter adapter into the urethra with the right hand, forcibly extends the penis with the left hand, and at the same time exerts considerable pressure about the adapter to prevent the dye from regurgitating. Twenty cubic centimeters of the dye is slowly but steadily injected, the operator's hands protected with $\frac{1}{8}$ inch of lead plate and the first exposure of a stereo pair is made. It is important to keep constant pressure on the plunger of the syringe at all times. While the plate is being changed the remaining 10 cc. is injected and the second exposure made. The anteroposterior roentgenogram is made by immediately placing the patient in the supine position and continuing the pressure on the plunger of the syringe. It is not necessary to mechanically remove the dye (Fig. 1).

DIAGNOSIS

Adenoma of the Prostate. Adenoma of the middle lobe or middle bar enlargement displaces the bladder anteriorly with angulation of the prostatic urethra as seen in the oblique view (Fig. 2). Adenoma of the

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FIG. 1. Normal cystourethrogram, oblique projection. The urethra leaves the bladder at right angles. The prostatic urethra is about 25–40 mm. long and 8–10 mm. in diameter. On the posterior wall arises the urethral crest or verumontanum. The membranous portion is 12 mm. long and 4–5 mm. in diameter. The spongy urethra is about 15 cm. in length and 15 mm. in diameter.

FIG. 3. Cystourethrogram, oblique projection, showing adenoma of median and lateral lobes of prostate. The median lobe of the prostate protrudes into the bladder without producing angulation. The widening of the prostatic urethra is due to pressure of the lateral lobes.

FIG. 2. Oblique projection. There is marked intraurethral and intravesicular spreading with lateral lobe projection into the bladder. The internal sphincter is dilated. The urethra is elongated. Lateral lobe enlargement.

FIG. 4. Prostate after removal, showing the adenoma involving all the lobes. Outline of bladder in dotted lines as seen in Figure 3.

Fig. 5. Urethral strictures. There is one sharp constriction in the cavernous portion about 6 cm. distal to the bulbus urethra. Additional constrictions of the bulbus urethra. The verumontanum visualizes well. Bladder elevated and prostatic urethra elongated.

Fig. 6. Cystourethrogram showing large tumor involving the right side of the bladder.

Fig. 7. Cystogram after partial withdrawal of contrast medium and injection of air, showing large tumor as in Figure 6.

Fig. 8. Cystourethrogram, oblique projection, with elevation of base of bladder due to enlargement of the prostate. There is a large diverticulum of the spongy urethra.

FIG. 9. Anteroposterior view of same case as Figure 8 showing lateral projection of diverticulum of urethra.

FIG. 10. Oblique projection, postoperative. Irregularity of proximal spongy, membranous and prostatic urethra due to instrumentation plus infection. Note funnel-shaped bladder outlet.

lateral lobes produces constriction of the prostatic urethra, demonstrated in the oblique view by widening of the prostatic urethra in the anteroposterior dimension, and by marked lateral constriction of the column when seen in the anteroposterior view. Enlargement of one lateral lobe displaces the prostatic urethra to the opposite side as seen in the anteroposterior view. Enlargement of all lobes elevates the entire bladder, with constriction and anterior displacement of the prostatic urethra (Fig. 3, 4 and 5).

FIG. 11. Oblique projection. Funnel-shaped vesicourethral junction after suprapubic prostatectomy. Membranous and spongy urethra normal.

Carcinoma and Other Tumors of the Bladder (Fig. 6). The location, extent, and sometimes the complications of tumor of the bladder can be better demonstrated by cystourethrography than by the usual cystograms, and, in conjunction with cystograms and intravenous pyelograms, completes the roentgenological examination of the bladder.

The opaque medium is more opaque and more viscid than the iodide solution used in cystograms, and these properties, along with the oblique and anteroposterior method of examination, frequently add needed diagnostic criteria (Fig. 7).

Pathological Conditions of the Urethra. Urethritis is shown by narrowing of the spongy urethra. Strictures are easily seen by this method, showing their location and extent.

Fistulas are demonstrated with or without added injection of the external sinus.

Abscesses of the prostate with fistulous openings into the urethra are seen as irregular saccules with narrow openings into the prostatic urethra. In our series no new growths of the urethra have been demonstrated. One diverticulum of the spongy urethra was easily demonstrated (Fig. 8 and 9).

Other Pathological Findings. Cystourethrograms before and after operations on the prostate give information on the effectiveness of the operation, and at times demonstrate the cause of unsatisfactory results (Fig. 10 and 11).

Cystourethrography when carefully executed and properly interpreted has added so much to the diagnosis and appraisal of methods of treatment that there is a growing demand for its use.

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TREATMENT OF PERITENDINITIS CALCAREA OF THE SHOULDER JOINT BY ROENTGEN IRRADIATION

REPORT OF ONE HUNDRED CASES

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WHEN we review the literature, we find that the study of peritendinitis calcarea of the shoulder joint has received wide attention in recent years. The consideration of this condition has been general and includes many articles on its diagnosis and pathology. By far the greater proportion of articles have dealt with treatment, however, because there are various methods currently employed. These methods of treatment have been fully discussed. Many articles have appeared on the surgical treatment of peritendinitis. Other articles have dealt with treatment by local injection. Many studies have been presented on the use of physiotherapy and some articles have investigated the value of roentgen therapy in the treatment of peritendinitis. In a previous article we have examined and discussed the relative results of these four methods of treatment.

The study which we present here deals only with the application and the results of roentgen therapy as it is utilized in the treatment of peritendinitis of the shoulder joint. One hundred cases were treated. The conclusions derived from the study are based primarily on the examination of the large number of cases. We have included in the study also some additional data that appeared in the course of our experience with these cases. Our study of the treatment of peritendinitis calcarea extends over a period of thirteen years. The earlier findings in our study have already been published. The cases presented in this paper cover a later period from 1937 to 1945. The one hundred cases of this series were divided, for therapeutic purposes, into the following three groups: acute, subacute and chronic. The cases were considered acute when the duration of the condition was under a month. They were classified as subacute if the condition extended over a two months' period, and whenever the condition had lasted for a period of more than two months, the cases were classified as chronic. Sixty-one per cent of the cases in this series were acute; 11 per cent were subacute and 28 per cent were chronic (see Table 1).

All the cases in the series were roentgenographed before they were given roentgen therapy. Two views of the patient were taken, one with the patient on his back, his back to the film and his arm to the side of his body in anatomical position with the palm up. The other view was taken with the patient on his back, his arm in neutral position with his forearm placed across his chest with the palm down. The tube was centered on the acromioclavicular joint, 36 in. distance; kilovoltage varied with the thickness of the part. A detail screen was used without a Potter-Bucky diaphragm.

The cases were usually given roentgen therapy, six to eight treatments. These treatments were applied anteriorly and posteriorly over a period of seven to fourteen days. They averaged 125 roentgens. The kilovoltage was determined by the thickness of the shoulder. It varied from 125–200 kv., 5–7 ma., 30–40 cm. distance, with a 10 by 15 cm. cone. When roentgen therapy was given, our average case improved within seven days. The 5 cases presented here are typical of the histories of our acute cases of peritendinitis of the shoulder joint. These cases were usually given one course of treatment. The subacute and chronic cases were generally

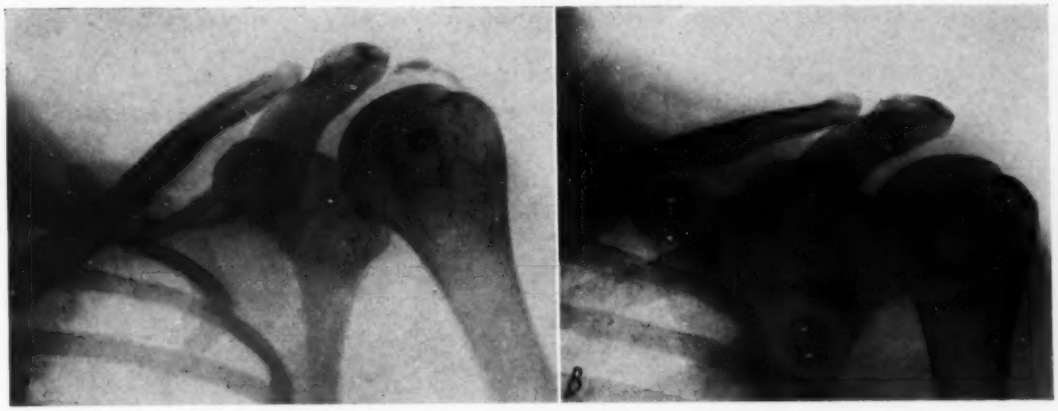

Fig. 1. Case 39. *A*, calcification near the greater tuberosity. *B*, complete resolution six weeks after roentgen therapy.

given more than one course.

The acute cases may be examined more carefully now in their case histories.

Case 39. Mrs. T, aged thirty-six, came to our office on July 5, 1941. She complained of an acute pain in her left shoulder of one week duration. She was a seamstress by occupation and had injured her shoulder by indirect trauma. The physical examination showed evidence of local pain, tenderness and limited abduction of 15 degrees. A roentgenogram taken at the time revealed an area of calcification adjacent to the greater tubercle of the left humerus. The patient was given eight roentgen treatments. The local symptoms disappeared after four days. A second roentgenogram was taken August 19, 1941, and showed a complete resolution of the calcification (see Fig. 1).

Case 42. Mr. F., aged twenty-six, came to our office December 16, 1941. He had injured his shoulder in reaching to close his automobile door. He complained of an acute pain in his right shoulder which had continued for five days. A physical examination showed swelling, tenderness and an abduction of 15 degrees. The patient received six treatments. After two days he had relief from pain. At the end of twelve days, he had complete abduction. When we compare the roentgenogram taken at the time of his first visit with a roentgenogram taken three months later, March 24, 1942, we note a residual trace of the calcification (see Fig. 2).

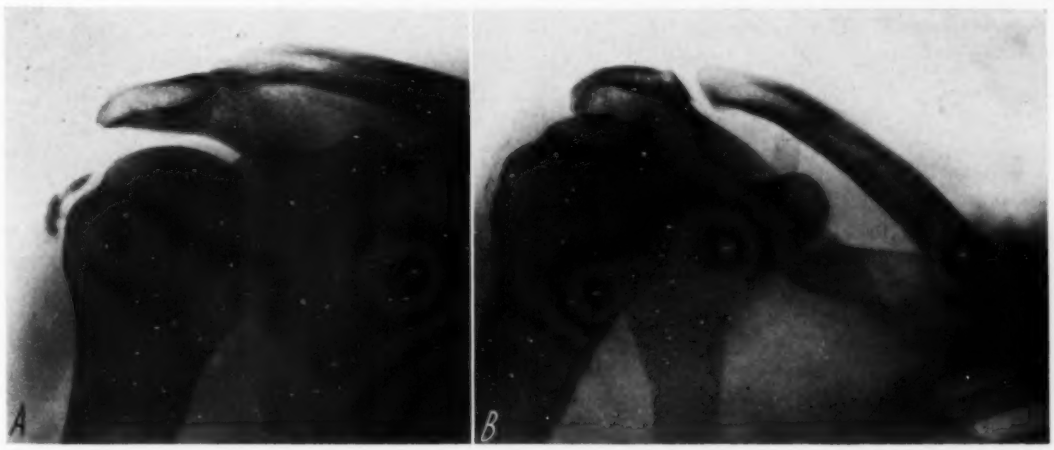

Fig. 2. Case 42. *A*, calcification near the greater tuberosity. *B*, roentgenogram taken thirteen weeks after roentgen therapy shows a residual trace.

TABLE I

No.	Name	Sex	Age yr.	Location	Type	Calcification	Disability days	Reduction
1	A.F.	M	36	Left	Acute	Yes	4	Yes
2	W.K.	M	49	Right	Chronic	None	25	None
3	S.F.	M	50	Left	Subacute	Yes	30	None
4	E.G.	F	37	Left	Subacute	Yes	10	Yes
5	M.W.	M	38	Right	Acute	Yes	10	Yes
6	W.P.	M	43	Left	Subacute	Yes	21	None
7	C.M.	F	35	Left	Acute	Yes	14	Yes
8	G.S.	M	34	Right	Acute	Yes	7	Yes
9	M.L.	M	51	Right	Acute	Yes	14	Yes
10	L.G.	M	36	Left	Acute	Yes	11	Yes
11	D.L.	F	44	Right	Acute	Yes	16	Yes
12	G.P.	M	58	Right	Subacute	None	12	
13	J.P.	M	62	Right	Acute	Yes	8	Yes
14	J.L.	M	36	Right	Acute	Yes	8	Yes
15	J.L.	M	49	Left	Acute	None	3	
16	E.L.	F	31	Right	Chronic	Yes	8	None
17	A.B.	M	51	Right	Acute	Yes	4	Yes
18	M.S.	M	37	Left	Acute	Yes	3	Yes
19	E.P.	M	67	Left	Chronic	Yes	7	Yes
20	L.B.	M	37	Right	Acute	Yes	13	Yes
21	R.P.	F	35	Right	Acute	Yes	10	Yes
22	J.A.	M	40	Right	Acute	Yes	11	Yes
23	E.M.	F	45	Left	Acute	Yes	7	Yes
24	I.L.	M	39	Left	Acute	Yes	15	Yes
25	C.M.	F	36	Right	Acute	Yes	3	Yes
26	E.G.	F	40	Right	Acute	Yes	10	Yes
27	L.R.	F	54	Left	Subacute	Yes	12	Yes
28	M.W.	M	61	Right	Chronic	Yes	14	Yes
29	W.L.	M	35	Right	Acute	Yes	5	Yes
30	M.S.	M	39	Right	Acute	Yes	7	Yes
31	D.T.	M	45	Right	Chronic	Yes	30	Yes
32	M.H.	F	36	Right	Acute	Yes	5	Yes
33	L.H.	M	40	Right	Acute	Yes	8	Yes
34	W.L.	M	35	Left	Acute	Yes	4	Yes
35	A.N.	F	51	Right	Subacute	Yes	13	None
36	J.F.	M	35	Left	Acute	Yes	17	Yes
37	M.S.	M	43	Left	Acute	Yes	3	None
38	R.W.	M	48	Left	Acute	Yes	5	Yes
39	A.T.	F	46	Left	Acute	Yes	4	Yes
40	F.S.	M	42	Left	Acute	Yes	10	Yes
41	J.H.	M	42	Left	Acute	Yes	3	None
42	J.F.	M	26	Right	Acute	Yes	12	Yes
43	E.V.	F	49	Right	Chronic	Yes	20	Yes
44	J.F.	M	45	Left	Acute	Yes	2	Yes
45	B.B.	M	35	Right	Chronic	Yes		Opera'n
46	N.A.	M	35	Left	Acute	Yes	9	Yes
47	S.G.	F	41	Right	Subacute	Yes	26	None
48	M.T.	F	46	Right	Chronic	Yes	75	Yes
49	R.K.	F	53	Right	Chronic	Yes	30	None
50	E.R.	F	44	Right	Chronic	Yes	30	Yes
51	P.T.	M	27	Left	Acute	Yes	4	Yes
52	E.B.	F	57	Left	Acute	Yes	9	Yes
53	S.H.	F	39	Right	Subacute	Yes	105	Yes
54	R.B.	F	41	Left	Acute	Yes	11	Yes

Table I (*Continued*)

No.	Name	Sex	Age yr.	Location	Type	Calcification	Disability days	Reduction
55	J.R.	M	54	Right	Chronic	Yes	55	None
56	A.W.	F	55	Right	Chronic	Yes	91	Yes
57	M.B.	F	29	Right	Acute	Yes	3	Yes
58	P.H.	F	48	Right	Acute	Yes	13	Yes
59	H.L.	M	44	Right	Acute	Yes	5	Yes
60	K.B.	M	37	Left	Subacute	None	30	
61	A.S.	F	58	Right	Acute	Yes	16	Yes
62	P.O.	M	50	Left	Chronic	None	17	
63	B.D.	M	48	Left	Chronic	Yes	52	Yes
64	I.R.	F	48	Right	Acute	Yes	2	Yes
65	A.R.	F	48	Left	Acute	Yes	4	Yes
66	V.M.	F	48	Left	Acute	Yes	2	Yes
67	M.S.	M	45	Left	Acute	Yes	7	Yes
68	F.B.	M	41	Left	Chronic	Yes	75	None
69	F.L.	F	52	Left	Chronic	Yes	75	None
70	I.R.	M	41	Right	Chronic	Yes		Opera'n
71	R.S.	M	55	Right	Acute	Yes	4	Yes
72	B.G.	F	56	Left	Chronic	None	4	
73	J.H.	M	51	Left	Chronic	Yes	90	Yes
74	W.I.	M	29	Right	Chronic	None	30	
75	S.U.	F	43	Left	Acute	Yes	9	Yes
76	M.E.	M	45	Left	Chronic	Yes		Opera'n
77	A.G.	F	39	Left	Acute	None	10	
78	A.A.	F	27	Left	Acute	Yes	6	Yes
79	M.Z.	F	60	Left	Subacute	None	3	
80	J.M.	M	38	Right	Acute	Yes	12	Yes
81	A.A.	M	43	Right	Chronic	Yes	30	None
82	M.M.	F	41	Right	Chronic	Yes	60	None
83	W.H.	M	34	Left	Chronic	None	60	
84	C.W.	M	55	Right	Chronic	Yes	45	None
85	N.S.	M	55	Right	Chronic	None	19	
86	A.Z.	F	57	Left	Subacute	Yes	30	Yes
87	J.H.	M	42	Left	Acute	Yes	7	Yes
88	A.H.	F	55	Right	Acute	Yes	2	Yes
89	H.M.	M	53	Left	Acute	Yes	6	Yes
90	M.F.	F	60	Left	Acute	Yes	14	Yes
91	C.M.	F	37	Left	Acute	Yes	3	Yes
92	M.M.	F	41	Right	Chronic	Yes	38	None
93	B.W.	F	40	Right	Acute	Yes	55	Yes
94	F.P.	M	62	Left	Acute	Yes	2	Yes
95	C.L.	F	38	Left	Acute	Yes	19	Yes
96	C.S.	F	52	Right	Acute	Yes	4	Yes
97	N.A.	M	43	Left	Acute	Yes	3	Yes
98	R.W.	F	29	Right	Acute	None	3	
99	H.K.	M	55	Left	Acute	Yes	2	Yes
100	C.L.	F	38	Right	Acute	Yes	19	None

Case 58. Mrs. H., aged forty-eight, came to our office September 17, 1942. On August 21 she had sprained her right shoulder. She had been treated from the time of the injury, until she came to our office, with physiotherapy which had not alleviated the condition. A physical examination showed pain, tenderness in her shoulder and a limited abduction of 25 degrees. A roentgenogram revealed an area of calcification in the right shoulder. She was given six roentgen treatments. Her symptoms disappeared after six days and her arm was freely

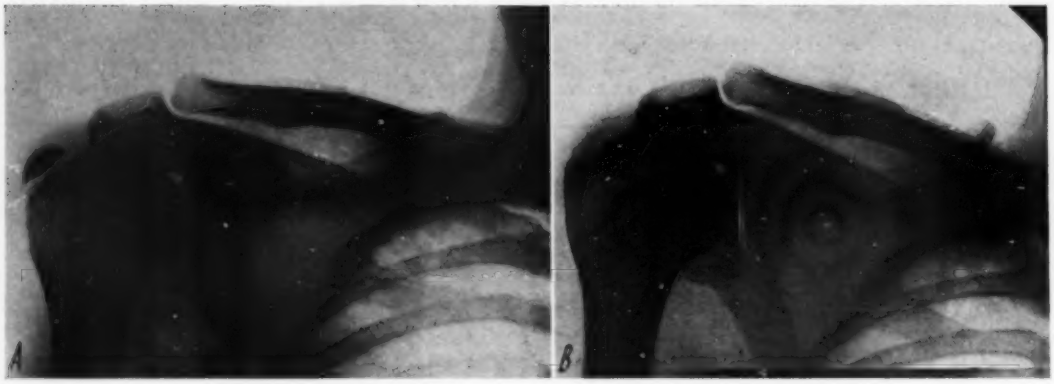

FIG. 3. Case 58. *A*, calcification near the greater tuberosity. *B*, final roentgenogram taken nineteen weeks after roentgen therapy shows a residual trace.

movable after thirteen days. A roentgenogram taken February 8, 1943, showed a residual trace of calcification (see Fig. 3).

CASE 94. Dr. P., aged sixty-two, came to our office September 6, 1944. He had suffered pain in his left shoulder for about two weeks. Ten days previous to the visit to our office, he had received a local injection treatment which had not improved the condition. A physical examination showed that he had pain and tenderness in his shoulder and an abduction of 15 degrees. The patient received eight roentgen treatments. After two days he had relief from pain and good abduction. A comparison between an roentgenogram taken at the time of his first visit and one taken a month later, October 26, 1944, showed a residual trace in the area of calcification (see Fig. 4).

CASE 15. Dr. L., aged forty-nine, came to our office July 13, 1939. He had complained of pain in his left shoulder for ten days. He had been given physiotherapy for six days. It had not alleviated his condition. A physical examination showed a marked tenderness and a limited abduction of 15 degrees. A roentgenogram did not show any calcification. The patient was given

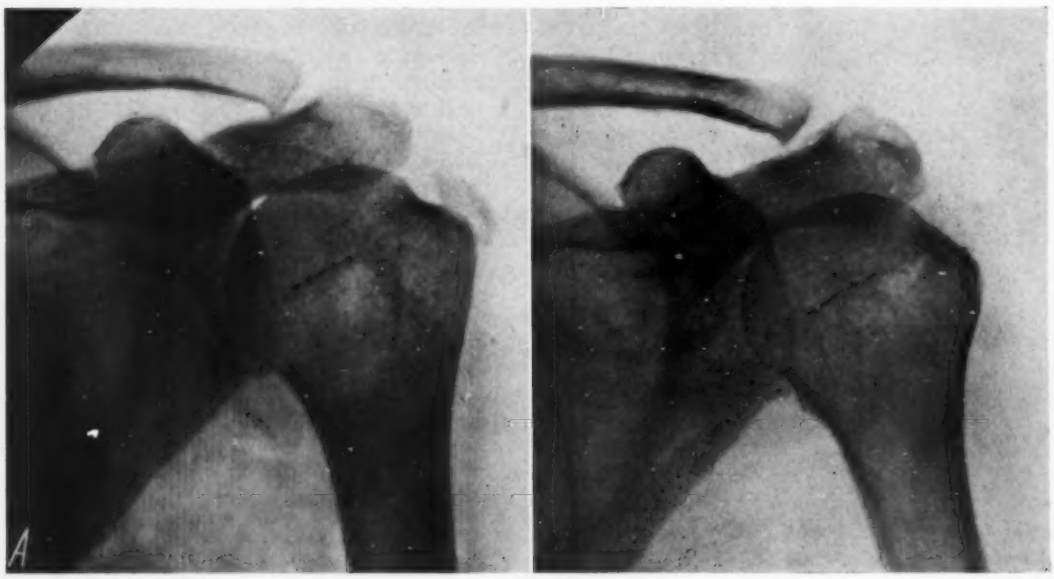

FIG. 4. Case 94. *A*, calcification near the greater tuberosity. *B*, roentgenogram taken six weeks after roentgen therapy shows a residual trace.

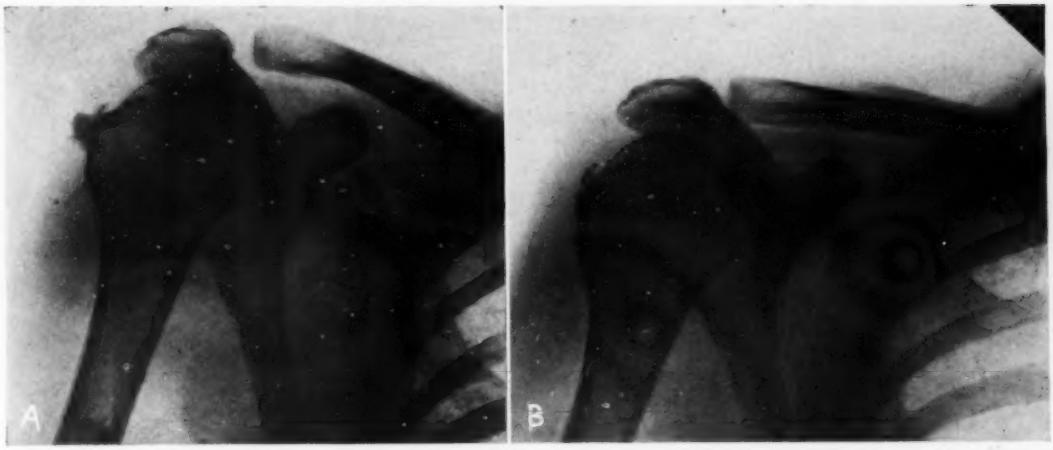

FIG. 5. Case 53. *A*, calcification near the greater tuberosity. *B*, roentgenogram taken seven months after roentgen therapy shows considerable resolution of the calcification.

three roentgen treatments. He had complete relief and good abduction in seventy-six hours.

It is important to note here that some acute cases, such as the last case presented above, in which no calcification can be seen in the roentgenogram may have some calcification microscopically.

McLaughlin* has pointed out that " . . . collections of tendon debris showing no opaque shadow by x-ray have been encountered not infrequently in the course of shoulder operations done for other conditions." These cases respond well to therapy.

In those cases where the calcification can be clearly seen in the roentgenogram, it can be demonstrated that the deposits tend to disappear after roentgen therapy. A tabulation of the acute cases shows a partial to complete resolution of the calcification in 69 per cent of the cases of peritendinitis of the shoulder joint after treatment. The results of roentgen therapy in acute cases of this condition are excellent in relief of all the physical symptoms associated with it.

The subacute cases, however, differ somewhat in their response to roentgen therapy. The disability period is longer, lasting an average of twenty-six days. These cases usually require two courses of treatment. Thirty-six per cent of these cases showed a reduction in the calcification after treatment. Eleven per cent of the cases presented in this paper were of the subacute type. The 2 cases, which we describe, are typical of the subacute cases.

CASE 53. Miss H., aged thirty-nine, came to our office June 10, 1942. She complained of pain in her right shoulder. She had had some discomfort for a year but the symptoms had become more acute in the last six weeks. During this time she had been treated with physiotherapy but the acute pain and limitation of motion had not been ameliorated. She was roentgenographed and given two courses of roentgen therapy. She had complete relief of symptoms within three months. A roentgenogram taken April 9, 1943, shows a reduction of the calcification (see Fig. 5).

CASE 47. Mrs. G., aged forty-one, came to our office February 8, 1942. She complained of pain in her right shoulder which had continued for six weeks. There was some limitation of motion and an abduction of 85 degrees. She was roentgenographed and an area of calcification was noted in her right shoulder. She was given one course of roentgen therapy. Her symptoms disappeared after twenty-six days. A roentgenogram taken November 17, 1942, showed no change in the calcification (see Fig. 6).

These 2 cases, presented above, should be considered when we study the chronic cases

* McLaughlin, H. L. Calcific deposits in the shoulder. *New York State J. Med.*, 1944, *44*, 2231–2235.

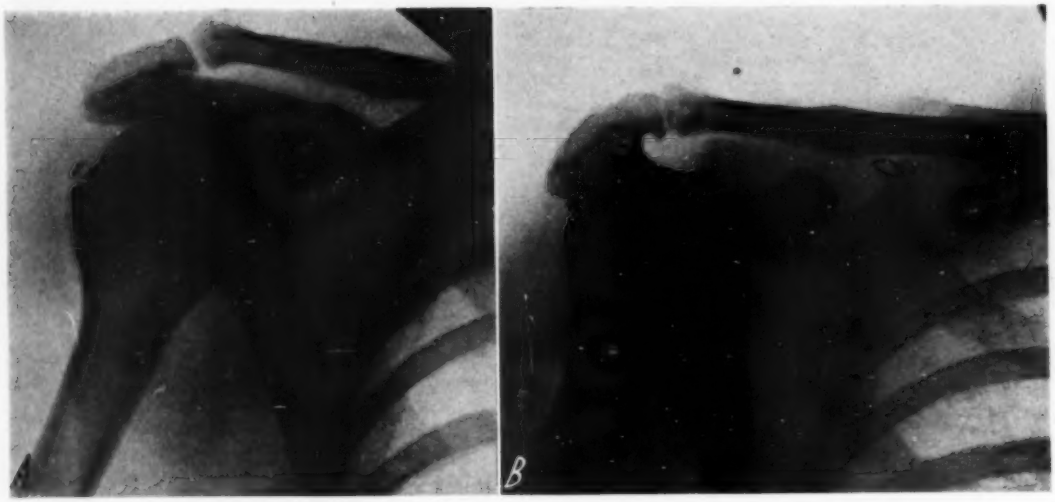

FIG. 6. Case 47. *A*, calcification near the greater tuberosity. *B*, no change in calcification.

to which they bear some resemblance. Twenty-eight per cent of the cases observed were chronic. We consider those cases chronic in which the condition continued over a period of more than two months. These cases have a disability period of thirty-six days and the response to treatment is similar to the subacute cases when they are given roentgen therapy. There was a 32 per cent reduction in the calcification in the chronic cases. The histories cited below are typical of the course of our chronic cases.

CASE 56. Mrs. W., aged fifty-five, came to our office August 20, 1942. For about eight months she had had indefinite symptoms in her right shoulder. About two months previous to her visit to our office, the symptoms had become acute. She had been treated with physiotherapy which had given her no relief. At the time of her visit to our office, she had pain and tenderness and a limited abduction of 45 degrees in her right shoulder. She was given two courses of roentgen treatment. She felt much better in twenty-five days and had a complete recovery in ninety-one days. The roentgenograms (Fig. 7), one taken on her first visit and

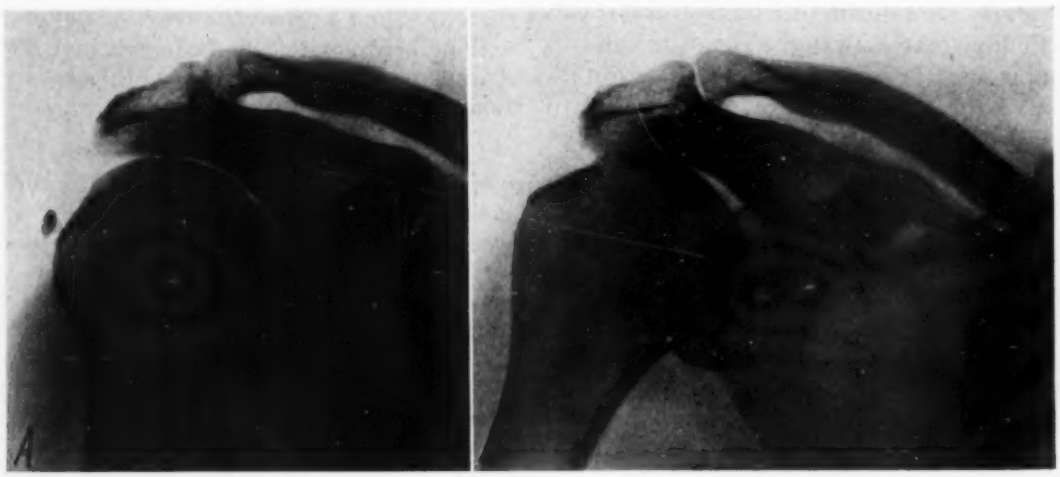

FIG. 7. Case 56. *A*, calcification near the greater tuberosity. *B*, roentgenogram taken one month after second course of roentgen therapy shows complete resolution of the calcification.

FIG. 8. Case 48. *A*, calcification near the greater tuberosity. *B*, roentgenogram taken eight weeks after roentgen therapy shows complete resolution of the calcification.

the other taken January 26, 1943, show complete resolution in the area of calcification after roentgen therapy.

CASE 48. Mrs. T., aged forty-five, came to our office February 10, 1942. She had had acute pain and tenderness in her right shoulder for over two months. A physical examination showed no limitation of motion. A roentgenogram taken at the time showed an area of some calcification. She was given two courses of roentgen treatment. She had complete relief of symptoms after seventy-five days. A roentgenogram taken April 28, 1942, showed a complete resolution of the calcification (see Fig. 8).

CASE 84. Mr. W., aged fifty-five, came to our office January 18, 1944. He complained of pain in the left shoulder for the past four months. A physical examination showed marked tenderness and limitation of motion and an abduction of 90 degrees. A roentgenogram was taken which disclosed an area of calcification. One course of treatment was given and the symptoms disappeared completely after forty-five days. A roentgenogram taken March 11, 1944 showed no change in the calcification (see Fig. 9).

These 3 cases are typical of the usual chronic condition in our series. However, we feel that it is important to note in this article 2 chronic cases which are of excep-

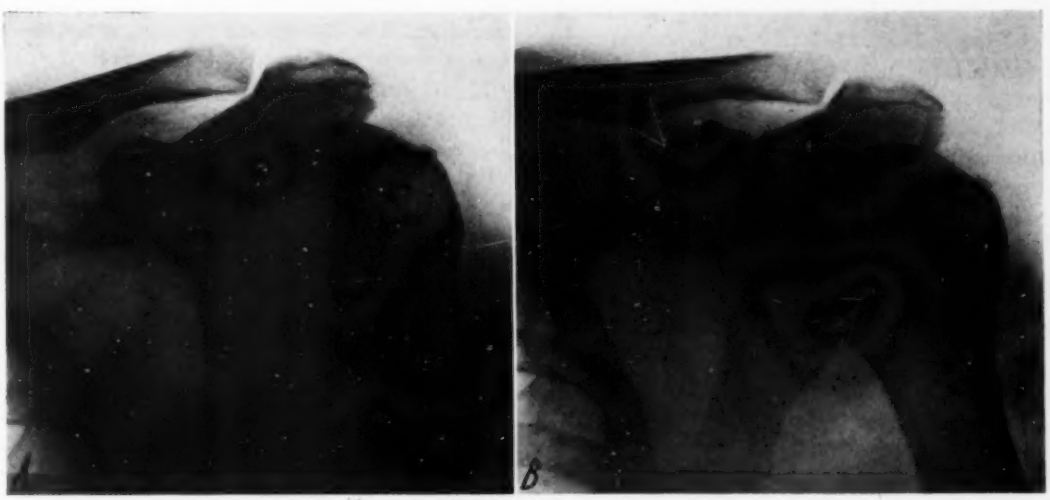

FIG. 9. Case 84. *A*, calcification near the greater tuberosity. *B*, roentgenogram taken one month after roentgen therapy shows no change in the calcification.

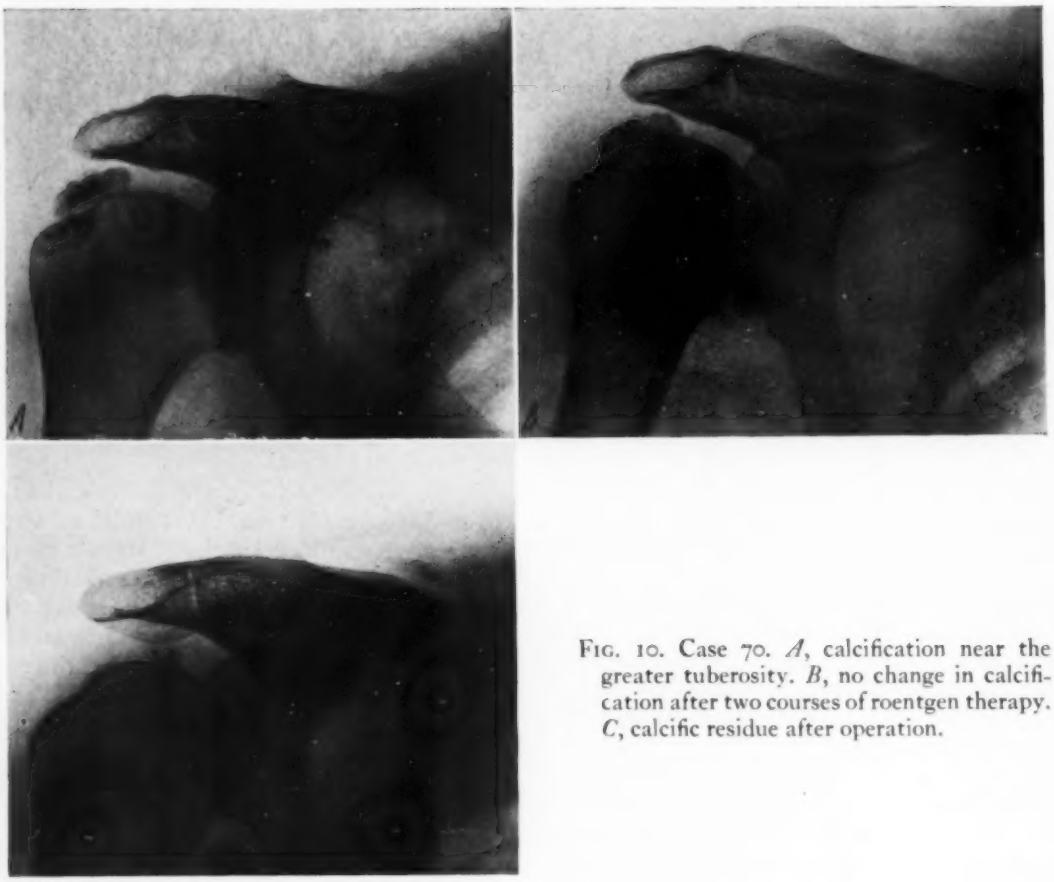

FIG. 10. Case 70. *A*, calcification near the greater tuberosity. *B*, no change in calcification after two courses of roentgen therapy. *C*, calcific residue after operation.

tional interest in the study of peritendinitis calcarea.

CASE 70. Mr. H., aged forty-one, came to our office May 8, 1943. He had been given extensive physiotherapy in 1937. When he came to us, a roentgenogram was taken which showed a large area of calcification. There was no limitation of motion noted in the physical examination. The patient was given two courses of roentgen therapy but he did not improve. We referred him to a hospital for operation. He was operated on in August, 1943. The operative report stated that "Calcification in the superspinatus tendon was removed with curette." The patient still complained of pain in his shoulder after the operation. A roentgenogram, taken at the time he returned to the office after the operation, showed a considerable residue of calcification left in his shoulder. In view of this case, it would seem advisable to take roentgenograms at the time of operation to make certain of the complete removal of the calcification (see Fig. 10).

CASE 45. Mr. F., aged thirty-five, came to our office January 23, 1942. He had developed pain and tenderness in his right shoulder six months before his visit to the office as a result of an accident. The symptoms had persisted and he was given needling and irrigation. The condition did not improve. When he came to our office, a roentgenogram was taken which showed a large, bone-like body adjacent to the greater tubercle (Fig. 11*A*). He was given one course of roentgen therapy. It did not relieve the condition. We suggested an operation and this was performed in June, 1942. A large osteochondroma (Fig. 11*B*) imbedded in the superspinatus tendon was removed, with good results.

It is evident that in those cases of peritendinitis in which the calcification is bone like, it is impossible to reduce it with roentgen therapy. However, where the bone formation is small, the patient may be relieved of his symptoms. Three of the cases in the series were sent for operation.

However, these chronic cases were exceptional.

Most of the 100 cases in the series followed definite patterns from which we are able to make certain deductions. These deductions relate to the value of roentgen therapy in the treatment of peritendinitis.

acute and chronic cases reacted similarly to treatment.

Those acute cases, which did not show calcification in the roentgenogram, were treated in the same manner as the other acute cases and were completely relieved.

Roentgen therapy had no effect in the

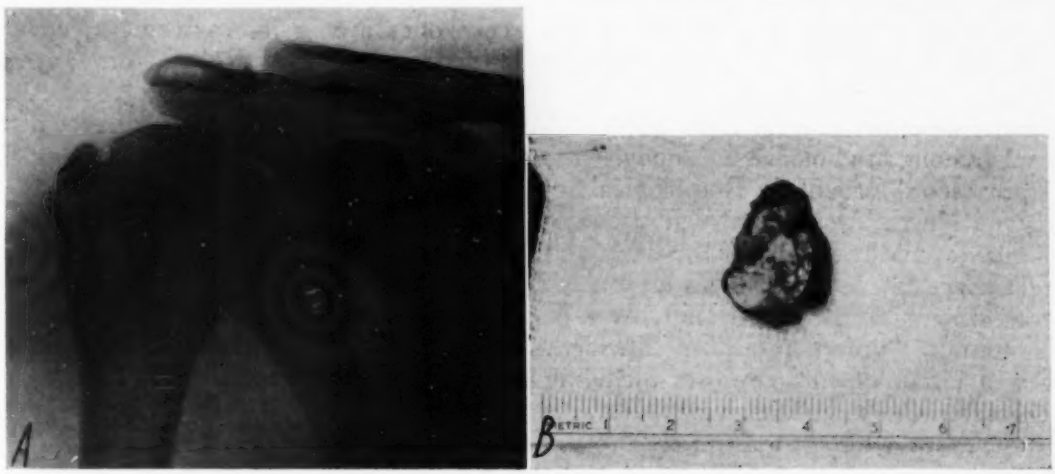

FIG. 11. Case 45. *A*, bone-like body near greater tuberosity. *B*, osteochondromatous loose body removed from shoulder.

It clarifies the use of the treatment to show how it was applied to the acute, subacute and chronic cases by dividing them into these three groups.

We have noted that of the three groups the acute cases responded the most successfully to roentgen therapy both in regard to the length of the disability period and in the reduction of the calcification.

The subacute and chronic cases responded less satisfactorily to the treatment than the acute cases. Their disability periods were generally longer but they had some reduction in the calcification. Subtreatment of those cases of calcification which had gone on to form bone that was sufficiently large to present a mechanical obstruction.

In conclusion, we feel that it is important to point out that the roentgen irradiation affects the acute inflammatory reaction of the condition, and therefore an effort should be made to treat cases of peritendinitis calcarea as soon as possible in order to achieve the best results.

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SIMPLIFICATION OF TISSUE DOSE ESTIMATION IN ROENTGEN THERAPY*

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THE need for determining tissue doses in roentgen therapy is generally recognized. But their estimation and recording in clinical practice, and the thinking in terms of tissue dose, are still far from being universal among radiologists. Though the therapy record form of the Radiological Society of North America, which provides columns for the recording of the daily and total surface and depth dose, is widely used, these columns are frequently left blank or still contain "grand totals" of incident doses in air or of surface doses including backscatter. One main reason for this status is the lack of ease in the application of the available fund of dosimetric information in routine roentgen therapy.

The direct measurement of tissue doses is only possible at the surface and in a few cavities. Fundamental difficulties connected with direct measurement of tissue dose tend to render the results of clinical measurements more inaccurate than the calculation from charts based on measurements of physical laboratories. Such charts and tables have been experimentally provided by various laboratories. The more recent ones are in fair agreement, cover a wide range of physical factors and are generally accessible.

While the data on the dependence of the skin dose D_o on the two determining factors, quality of radiation and area of irradiated field, can easily be presented in graphs or tables from which the percentage backscatter, or alternatively the incident dose in air D necessary for 100 r skin dose can be read off immediately for a wide variety of treatment conditions (Table 1), the greater number of interconnected factors does not allow a similar simplicity in the determination of the depth dose D_n. It requires the use of different sets of isodose charts. Routine depth dose determination is, as a rule, limited to the calculation of depth doses in the central beam from depth dose tables. Different radiation qualities require different sets of tables. A single quality requires different tables or conversion factors for different focus-skin distances. For a single case the use of one or more sets of tables becomes necessary

TABLE I

ROENTGENS IN AIR PER 100 ROENTGENS ON SKIN (INCLUDING BACKSCATTER)

Half-Value Layer mm. Cu	Area in cm.²							
	5	20	50	75	100	150	225	400
0.25	88	82	77	75	73	70	69	67
0.5	87	81	76	74	72	69	68	66
1.0	88	82	77	75	74	71	70	67
1.5	89	85	79	77	76	74	73	69
2.0	91	86	83	81	79	77	76	73

After Quimby,[3] Fig. 65 and 66.

* Presented at the Joint Meeting of the American Roentgen Ray Society and the Radiological Society of North America, Chicago, Ill., Sept. 24–29, 1944.

whenever flexibility of treatment regarding area, radiation quality and distance is essential.

In the search for simplification of depth dose estimation for clinical purposes various workers,[1] among whom Packard[2] has been the proponent in this country, have attributed to the percentage depth dose in 10 cm. PD_{10}, D_{10} expressed as percentage of D_0, a similar significance regarding dosage distribution in the irradiated tissue as has been assigned to the half-value layer in the characterization of radiation quality. They pointed out that in a similar way as the half-value layer sufficiently characterizes a radiation quality for clinical purposes, though it represents only one point of its absorption curve, the percentage depth dose in 10 cm., which informs precisely only on the radiation intensity in the depth of 10 cm., informs also with clinically sufficient exactness, within the limits of roentgen therapy, with medium qualities at least, on the intensities in other depths than 10 cm., independent of the combination of variable factors with which it is obtained.

By neglecting, for clinical purposes, the variation of percentage depth doses PD_n in central beams with identical PD_{10}, it becomes possible to prepare one table which allows one to read off immediately PD_n in dependence on PD_{10}. PD_{10} can be determined from a second table in dependence on the three main factors influencing depth dose, radiation quality, focus-skin distance and area of irradiated field. All data necessary for depth dose estimation for a continuous range of qualities and the customary combination of distance and field factors in this range can be provided by these two tables.

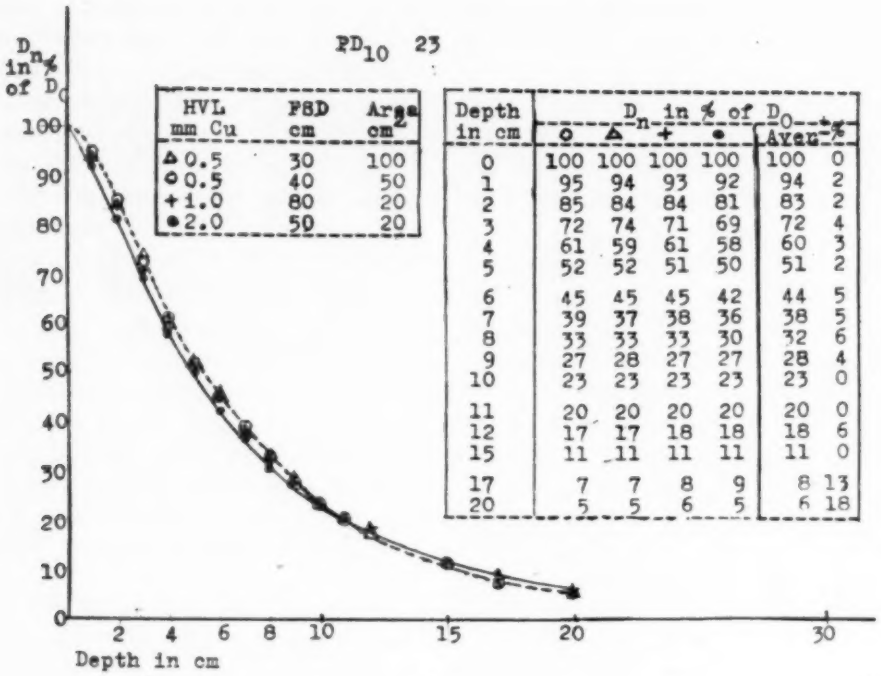
This simplified method of depth dose estimation stands or falls with the accuracy that it affords. The margin of error which it introduces has been determined previously[1,2] as $\pm 2-5$ per cent. As these figures were derived from depth dose data which did not yet cover the wide range of variation of factors of more recent measurements and in part might be subjected to criticism concerning the experimental technique, I reviewed from the same angle the most recent data, published by Quimby[3] in 1944 for qualities of half-value layer 1 mm. Al–2 mm. Cu, and for harder rays of half-value layer 2–5 mm. Cu the tables published by Mayneord and Lamerton[4] in 1941.

Comparison of sets of percentage depth doses in central beams with identical PD_{10} obtained with extremely different treatment factors reveals the maximum differences that may occur in other depths than 10 cm. and the margin of error in the case of the substitution of an average for the two different sets. In clinical practice the differences will be smaller because the more commonly used combinations yield, as a rule, depth doses between those of the extremes.

Figures 1 and 2 show examples of such comparisons graphically and in tables. Figure 1 is representative of a lower range of PD_{10}, in which the medium radiation qualities of half-value layer 1–2 mm. Cu overlap with softer radiations of half-value layer 0.25–0.5 mm. Cu, and Figure 2 of a higher range of PD_{10}, in which they overlap with harder radiations of half-value layer 3–5 mm. Cu. At both levels, as in the intermediate range, the percentage doses in depths less than 10 cm. are higher for softer than for harder rays and vice versa in greater depths. The relative influence of area and distance is less uniform. However, we are here not concerned with the analysis of the different factors influencing depth dose but with the range of differences in beams with identical PD_{10}.

The differences tend to be smaller in beams with high than with low PD_{10} up to PD_{10} 54. This point is of interest in view of the present trend to use voltages above 200 kv. However, I have not reviewed any data on beams with PD_{10} above 54.

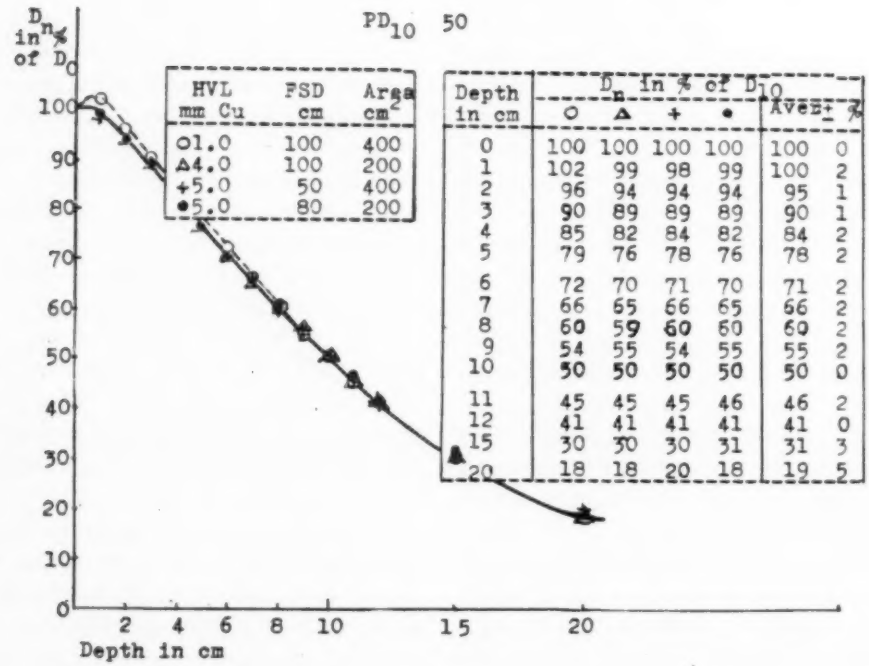
The differences of doses in beams with identical PD_{10} below 10 increase rapidly to 20 per cent and more. PD_{10} cannot be used as a guide in depth dose estimation in superficial roentgen therapy. It has never been recommended in this field.



HVL mm Cu	FSD cm	Area cm²
△ 0.5	30	100
○ 0.5	40	50
+ 1.0	80	20
● 2.0	50	20

Depth in cm	Dn in % of D0 ○	△	+	●	Average	± %
0	100	100	100	100	100	0
1	95	94	93	92	94	2
2	85	84	84	81	83	2
3	72	74	71	69	72	4
4	61	59	61	58	60	3
5	52	52	51	50	51	2
6	45	45	45	42	44	5
7	39	37	38	36	38	5
8	33	33	33	30	32	6
9	27	28	27	27	28	4
10	23	23	23	23	23	0
11	20	20	20	20	20	0
12	17	17	18	18	18	6
15	11	11	11	11	11	0
17	7	7	8	9	8	13
20	5	5	6	5	6	18

Fig. 1



HVL mm Cu	FSD cm	Area cm²
○ 1.0	100	400
△ 4.0	100	200
+ 5.0	50	400
● 5.0	80	200

Depth in cm	Dn in % of D10 ○	△	+	●	Average	± %
0	100	100	100	100	100	0
1	102	99	98	99	100	2
2	96	94	94	94	95	1
3	90	89	89	89	90	1
4	85	82	84	82	84	2
5	79	76	78	76	78	2
6	72	70	71	70	71	2
7	66	65	66	65	66	2
8	60	59	60	60	60	2
9	54	55	54	55	55	2
10	50	50	50	50	50	0
11	45	45	45	46	46	2
12	41	41	41	41	41	0
15	30	30	30	31	31	3
20	18	18	20	18	19	5

Fig. 2

For beams with PD_{10} 10–50, obtained in so-called deep roentgen therapy, I found in depths less than 10 cm. maximum differences of 12 per cent, or an error of ± 6 per cent for a substituted mean. In depths below 15 cm., where the percentage figures become very small, their variation may in the range of 12 per cent by physical factors alone. What degree of exactness can we, in the present stage of dosimetry, reasonably expect to obtain in tissue dosage estimation? We have to concede that at its best it gives only approximations.

The differences in the data from different

TABLE II

VALUES OF PERCENTAGE BACKSCATTER
COMPARISON OF VALUES AFTER QUIMBY AND AFTER MAYNEORD

Half-Value Layer mm. Cu	Area of Field in cm.²											
	20		50		100		150		200		400	
Author	Q	M	Q	M	Q	M	Q	M	Q	M	Q	M
0.5	24	14.6	32	25.0	39	33.0	43	37.0	47	39.7	55	43.0
1.0	22	16.7	30	26.0	37	33.9	41	38.0	44	41.0	53	45.2
1.5	18	14.3	26	22.7	32	30.5	36	34.3	39	37.1	45	42.4
2.0	15	12.6	22	20.0	28	27.4	31	31.0	34	33.3	40	37.7
3.0	11	10.0	16	16.0	22	22.5	25	25.3	28	27.5	31	31.0
4.0	9	8.0	13	13.4	18	19.0	22	21.6	23	23.5	27	26.5

TABLE III

VALUES OF PERCENTAGE DEPTH DOSE IN 10 CM.
COMPARISON OF VALUES AFTER QUIMBY AND AFTER MAYNEORD

Area cm.²		20				50				100				400			
Half-Value Layer mm. Cu		1		2		1		2		1		2		1		2	
Author		Q	M	Q	M	Q	M	Q	M	Q	M	Q	M	Q	M	Q	M
Focus-Skin Distance	40	19	22	21	24	23	27	26	29	28	32	31	34	38	44	40	46
	50	20	22	23	25	25	28	28	30	30	33	34	36	41	45	44	48
	80	23	24	27	27	29	30	33	32	34	35	39	38	46	49	50	51

The values after Mayneord and Lamerton in Tables II and III represent mean values obtained from the literature including their own measurements.

reach ± 20 per cent. The maximum differences above 10 cm. are not found, as previously, in the first few centimeters but in greater depths.

What is the significance of an error of this magnitude for our purpose? We do not want to uncritically increase the inaccuracy of dosage which is already, according to Quimby's estimation, under best conditions laboratories, with which we have to cope whenever we compile, compare or reproduce irradiation effects reported in the literature, are still in the same range as the variations of percentage doses in beams of equal PD_{10} (Tables II and III).

Tissue doses which are calculated in central beams and for their crossing points determine only maximum dosage in one or

several geometrically defined points within the lesion. The determination of the as or more important minimum dose in its borders remains more inaccurate even if isodose charts are being used. They are not published for the same great variety of combinations of treatment factors as tables on depth dose in the central beam. Those that are available from different sources show greater discrepancies in the periphery than in the center of the beam.

that the logarithms of percentage depth doses, if plotted against the depth, tend to fall in straight lines. His method of determining PD_{10}, however, required three steps, the use of one graph and of two nomograms. These four steps can be replaced by only two readings from Tables IV and V.

The two tables cover the factors of average deep roentgen therapy. Both are obtained from the latest depth dose tables by Quimby.[3] The values of PD_{10} in Table

TABLE IV

PERCENTAGE DEPTH DOSE IN 10 CM. FOR VARIOUS COMBINATIONS OF TREATMENT FACTORS

Focus-Skin Distance	Area cm.²	5					20					50					75				
in cm.	Half-value layer mm. Cu	0.25	0.5	1.0	1.5	2.0	0.25	0.5	1.0	1.5	2.0	0.25	0.5	1.0	1.5	2.0	0.25	0.5	1.0	1.5	2.0
30		9	13	14	15	15	13	15	18	19	20	17	19	21	23	24	19	21	24	25	27
40		10	14	15	16	16	14	16	19	20	21	19	21	23	25	26	21	23	26	28	29
50		11	14	16	17	18	15	18	20	22	23	20	23	26	27	28	23	25	28	30	31
60		11	15	16	18	20	16	19	21	23	25	20	24	27	29	30	23	26	30	32	33
70		12	15	17	19	21	16	20	22	24	26	21	25	28	30	32	24	27	31	34	35
80		12	16	18	20	23	17	21	23	26	27	22	26	29	32	33	25	28	32	35	36
100		13	17	19	20	24	18	22	24	27	28	23	27	30	33	34	26	29	33	36	38
Focus-Skin Distance	Area cm.²	100					150					225					400				
in cm.	Half-value layer mm. Cu	0.25	0.5	1.0	1.5	2.0	0.25	0.5	1.0	1.5	2.0	0.25	0.5	1.0	1.5	2.0	0.25	0.5	1.0	1.5	2.0
30		21	23	25	27	28	23	26	28	30	31	25	28	30	32	34	28	31	33	34	35
40		23	26	28	30	31	25	28	31	33	34	28	31	33	35	38	31	34	38	40	42
50		25	27	30	32	34	27	30	33	35	36	31	33	35	38	40	33	37	41	43	44
60		26	28	32	34	36	28	31	35	37	38	32	34	37	40	42	34	39	43	46	47
70		26	29	33	36	38	29	32	37	39	40	32	35	39	42	43	36	40	45	48	50
80		27	30	34	37	39	30	33	38	40	42	33	37	41	43	45	37	42	46	49	51
100		27	31	35	38	41	31	34	39	41	44	33	38	42	44	46	38	43	48	50	52

(Values after Quimby)

In this situation the use of PD_{10} as guide in depth dose estimation appears justified when its limitations are kept in mind. If the results of the simplified method of estimation are regarded as a first draft, it will stimulate the better utilization of more accurate data in selected cases rather than eliminate it.

Packard presented a simple graphical method of determination of PD_n in dependence on PD_{10}, based upon the finding

IV are taken either directly from individual tables for tabulated combinations of physical factors or, for combinations not covered by the tables, from curves obtained from their data. Table V is prepared from the same tables by substituting mean values for different sets of percentage depth dose values of beams with identical PD_{10} obtained by various combinations of physical factors as shown in the examples in Figures 1 and 2.

The first reading, from Table IV, furnishes PD_{10} for any combination of physical factors, the second reading, from Table V, PD_n in the depth of n cm. The finding of PD_n in the right column of Table V is facilitated by the superscription of the values of PD_{10}.

The final step of calculating the actual depth dose D_n in n cm. depth in tissue roentgens is a multiplication which becomes extremely simple if the dosage prescription is made in round figures for the surface dose including backscatter instead, as usually preferred, for the incident dose measured in air.

Prescription in surface tissue dose by exposure time is simplified by tabulating the roentgens in air for 100 r surface dose, in the manner of Table I, and adding the exposure times necessary for each percentage dose in air with all techniques in use.

The simplification for routine estimation and recording of depth doses which Tables IV and V offer by doing away with readings from a multitude of individual tables is not only experienced in working with markedly different techniques but also in dealing with slight changes becoming frequently necessary in a course of treatments.

As an example, let us consider the following case, illustrating a rather common situation. A lesion in 5 cm. depth has been treated with the following combination of factors: half-value layer 1.0 mm. Cu, focus-skin distance 50 cm., area of field 10×10 cm.^{2} and a daily surface dose D_o of 300 r. The daily depth dose D_5 was 180 r. It is desirable to decrease the area of field to 4×5 cm.^{2} without essential change in the daily depth and surface dose. Which changes of physical factors have to be made for this purpose? Table IV informs us that while PD_{10} was 30 with the old combination of factors, it is for an area of 4×5 cm.^{2} only 28 at its best, if the half-value layer is raised to 2.0 mm. Cu and the focus-skin distance to 100 cm. Table V shows a drop from 60 to 58 in dependence on PD_{10} 30 or 28 respectively. This difference of only 2 per cent, which means a drop from 180 r to 174 r daily D_5, is within the limits of accuracy of dosimetry. We, therefore, choose the new

TABLE V

DEPTH DOSES IN PERCENTAGE OF SURFACE DOSE FOR PERCENTAGE DEPTH DOSES IN 10 CM. 10–50

Depth cm.	Percentage Depth Dose in 10 cm.																				
	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1	77	84	87	88	90	92	93	94	95	97	98	99	99	100	100	101	101	101	102	103	104
2	61	69	73	75	78	81	83	84	86	89	90	91	92	93	93	95	97	99	100	100	100
3	48	56	61	62	65	68	70	72	74	78	80	81	82	83	84	87	88	89	92	92	93
4	37	44	48	49	53	57	60	61	64	68	70	72	74	75	76	78	80	82	85	86	87
5	29	35	38	41	44	47	50	52	55	58	60	63	65	67	68	71	72	74	77	78	79
6	24	26	30	33	37	40	43	45	47	51	53	55	57	59	61	62	64	66	69	70	72
7	19	21	23	27	31	34	36	39	41	44	46	48	50	52	53	56	58	60	63	64	65
8	15	17	19	23	26	30	32	33	35	38	41	42	44	47	48	50	52	53	57	58	59
9	12	14	16	19	21	24	26	27	30	33	35	37	39	41	42	44	46	48	50	52	54
10	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
11	8	10	12	14	16	17	19	21	23	25	26	28	30	32	33	36	38	40	41	43	44
12	7	8	10	11	13	15	17	18	20	22	23	25	27	28	29	33	34	36	37	39	40
13	6	7	8	9	11	12	14	15	17	19	20	21	23	25	26	28	30	32	33	35	37
14	5	6	7	8	9	10	12	13	15	16	17	19	20	22	23	26	27	28	29	31	33
15	4	5	5	6	8	9	10	11	13	14	15	17	18	19	20	23	24	25	26	28	31
16				5	6	8	8	10	11	12	13	14	15	16	18	20	21	22	23	25	27
17				4	5	6	7	8	9	10	11	12	13	14	15	18	18	19	20	22	24
18				3	4	5	6	7	8	9	10	11	11	12	14	16	16	17	18	20	21
19				2	4	5	5	6	7	8	9	10	10	11	11	14	14	15	16	18	19
20				2	3	4	5	6	7	8	8	9	9	10	11	12	12	13	14	16	17

combination of factors half-value layer 2.0 mm Cu, 100 cm. focus-skin distance, 4×5 cm². area and record the changed daily depth dose of 174 r.

The estimations require a minimum of time. They are made instantaneously with the change of area and without essential delay of the treatment. It is their deferment to a later time which so frequently leads to their omission.

The available data for the calculation of percentage depth doses from the incident dose in air offer a valuable and convenient short cut for checking purposes as long as the dosage prescriptions are made in roentgens measured in air. The exclusive application of this method of simplification of depth dose estimation, as outlined by Roth,[5] however, would eliminate the indispensable information on the surface dose and support rather than eradicate the confusion regarding dosage expressions in terms of physical and of tissue dose.

Routine estimation of approximate tissue doses as percentages of the surface dose and the drafting of their distribution in the depth and on the surface is made possible in clinical practice by the ease provided by the method of taking PD_{10} as guide and using only two tables for all purposes. While measurements and depth determinations remain the share of the physician, every technician can learn to read the two tables and record the daily doses reliably despite changes in technique.

The main points in which routine tissue dose estimation and recording have proved to be eminently helpful are: (1) the intelligent and individualizing conduct of treatments, (2) the accumulation of information, such as data on depth intensity and daily depth dose, allowing a better evaluation and correlation of radiation effect and dosage, and (3) an educational influence by detaching the thinking of the radiologist from merely physical factors and concentrating it on the biological and therapeutic part.

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Chicago 37, Ill.

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DISCUSSION

DR. EDITH H. QUIMBY, New York. Dr. Hamann has worked out an extremely ingenious and interesting method for correlating the dose at any depth within the tissues with something which is in effect a measure of the quality of the radiation, namely, the amount of radiation delivered at a depth of 10 centimeters in the phantom. She has gone one step further than Mayneord, who made such a correlation with half-value layers, including the extra statements of distance and field.

She has succeeded in reducing all depth dose data to two tables, but I must say I can't see the practical application of it as preferred to the ordinary depth dose tables which are generally employed.

Dr. Hamann has made several points in her paper which I would like to try to answer step by step.

In the first place, she says—and it is unfortunately true,—that there are a great many radiologists who at the present time are not recording tissue doses as would be to their best advantage. Since this is true, anything we do to promote such recording is greatly to be desired. I doubt whether giving them two charts whose use they would have to learn by rote would help. Methods of using standard depth dose tables are straightforward. The fact that they are on several pages instead of two is of no importance. It is not a great intellectual feat to find the proper page.

Dr. Hamann makes the point, which is an extremely important one, that at the present time we can only measure depth doses along the axis of the beam. That is true. She also makes the point that there are greater discrepancies

among various workers who have published isodose charts, among the doses at the edges of the isodoses than in the center. That is true, too, and will continue to be true until we develop some satisfactory method for measuring distribution of radiation near the edge of the beam in the phantom. That is a problem which the physicists still have to face, and it is to be hoped that some time soon it will be solved. But that is beside the point at present; Dr. Hamann's tables offer no more aid in this problem than do any others dealing only with doses along the axis of the beam.

She agrees that the method which she advocates is not applicable to superficial therapy. It is in that region that, at the present time, we have the greatest scarcity of accurate information. However, her data are applicable to the range of high voltage and supervoltage therapy. She has made up her tables from published tables for these qualities of radiation. To me this appears only as introducing an unnecessary complication into the use of the published material.

The point she makes that it is necessary to know the skin dose in order to have the best information about therapy is certainly correct. We want to know three things: We want to know the dose in air because our machines are calibrated in air and that is the way we determine the length of time to run the machine. We want to know the dose on the skin because we are limited by this dose in the amount of radiation we can administer. We want to know the dose where the tumor is, because this is actually the dose which will or will not cure.

Now this tumor may be in the skin, or it may be at any depth whatever. I'm afraid the introduction of an intermediary D-10 will, far from simplifying the matter, confuse radiologists to the point where they think D-10 is the only thing that needs recording and not bother to go any further. As a matter of fact, I have encountered that difficulty already in talking to people about tissue doses. I have asked a number of people at different times about how they determine tissue dose or what tissue dose means and some of them say, "Oh, that is the dose at ten centimeters." Of course it isn't, but if we introduce such an intermediary term, I'm afraid that we will be introducing confusion rather than taking it out.

The published tables from which Dr. Hamann has taken her data contain on each page the dose in air, and the dose at every depth, including zero depth, which is the skin; and they are put up in two forms: on one page is the dose at various depths for 100 r in air, in which case of course the dose on the skin is greater than that by the backscatter. If, however, it is desired to start with 100 r on the skin, the other page gives all doses in relation to this. In this case of course the dose in air is lower than 100 r.

I am at a loss to find anything in these tables beyond an interesting fact that the available information on depth doses can thus be correlated,—it is interesting and may turn out to be important, but as far as its practical immediate application is concerned, my feeling is that the radiologist would be more confused by having two arbitrary tables to work with than he would be by having a dozen pages of straightforward tables of the sort to which he is beginning to become accustomed.

Dr. Hamann (closing). I am very grateful for the discussion by Dr. Quimby. Her apprehension that the presented method might cause confusion appears in my opinion unfounded, as an understanding of the interrelations of factors determining tissue doses is necessary for all depth dose estimations and should enable anyone to use the presented condensed tables as well as the individual ones.

While for a single depth dose determination the use of an individual table covering exactly the combination of treatment factors in the given case is undisputably the simplest procedure the presented method is concerned with the simplification of routine depth dose estimation and recording in the average roentgen practice, where it is very frequently omitted when the use of a great number of tables becomes necessary.

Clinically speaking, there is another factor favoring these omissions. That is the relatively great number of patients, seen in every roentgen practice, receiving palliative treatments only. In these cases, tissue dose estimation is usually regarded as not worth the effort, whereas, simplified estimation, which can be done rapidly and with a minimum of effort, furnishes not only the basis for their best management but also contributes to the accumulation of data of radiological interest.

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Committee on Arrangements: To be appointed.

Twenty-ninth Annual Meeting, 1947: To be announced.

EDITORIAL

THE GENETIC EFFECTS OF RADIATIONS

The sterilizing power of the roentgen rays was noted soon after their discovery half a century ago. Numerous studies have been carried out since then by irradiating ova or sperm and observing the anomalous developments, particularly in relation to the change of configuration of the chromosomes. It was not, however, until 1927 that Muller[1] first found that the roentgen rays could also produce gene mutations which may lead to abnormal distribution of the hereditary material without demonstrable change in the composition of the chromosomes themselves. This at once gave such impetus to genetic investigations that a vast literature dealing with all phases of the subject grew up within a relatively short time.

Recently an excellent series of articles on experimental and applied radiobiology have been published in the *British Medical Bulletin*. Several of the authors discuss the genetic effects of the roentgen rays and other radiations, giving a very comprehensive summary of the present state of research in this field.

Spear,[2] after reviewing some of the most important contributions states that it is now generally realized that the alterations in the chromosomes are of at least two kinds: (1) changes in the linear arrangement of the chromosome threads, resulting from single or double breakage; and (2) changes in the composition of the genes or unit hereditary particles, without disturbance of their position on the chromosome thread (gene mutation). The first are important from the point of view of study of the immediate effect of the radiation. Inasmuch as the injury is irreversible it is possible to evaluate the hits of the particular radiation used fairly accurately. The second kind of changes may not exert an effect for several generations, causing infertility in the later offspring.

Insects and plants furnish the most suitable material for genetic investigations since they have a small number of chromosomes of large size. According to Spear an added advantage is the fact that no matter at what point in the life cycle of the cells the irradiation is undertaken, the changes are best recognized in the metaphase and anaphase of the division. Exception is made for some of the cells irradiated in the very early mitotic stage which may disintegrate in the late prophase or early metaphase and thus may be missed in the anaphase count. The principal organisms used by the various investigators are the fruit fly (*Drosophila melanogaster*), maize, some fungi (*Neurospora*) and the flowering plant (*Tradescantia*).

Catcheside,[3] a most eminent worker in cytogenetics, in discussing the irradiation-induced chromosome aberrations, distinguishes between irradiation during the resting phase of the cell and irradiation at the early prophase. During the former the chromosomes are hit when they are simple undivided threads so that both the chromatids are similarly affected. During the latter a division has already set in and therefore only one of the two chromatids is affected at a given place. It is assumed by Lea and Catcheside[4] that the chromosome or chromatid breaks as a result of the passage through it or its immediate vicinity of a

[1] Muller, H. J. Artificial transmutation of the gene. *Science*, 1927, *66*, 84–87.

[2] Spear, F. G. Biological effects of penetrating radiations. *Brit. Med. Bull.*, 1946, *4*, 2–11.

[3] Catcheside, D. G. Genetic effects of radiations. *Brit. Med. Bull.*, 1946, *4*, 18–24.

[4] Cited by Catcheside.[3]

single ionizing particle of a sufficiently dense ionization. Experimentally it was found that particles producing at least 200 ions per micron of track are required to accomplish a complete break in *Tradescantia*. In other cells and organisms it is different.

According to Catcheside[3] the breaks in the chromosomes suffer various fates. Under certain conditions about 90 per cent of them reunite in the original way so that no permanent effect can be seen. Others undergo reunion in new ways leading partly to viable and partly to defective chromosomes. Still others never reunite, two fragments resulting in the end, one centric and the other acentric. Chromatid-breaks produce a series of analogous changes.

In the estimation of Catcheside[3] the yield of persistent chromosome and chromatid-breaks is linearly proportional to the dose but is independent of the radiation intensity in case of the roentgen rays, neutrons and alpha particles. This means that simple breaks are products of single radiation hits.

However, the yields of interchanges and other two-break aberrations show a somewhat different behavior. For the roentgen rays these yields diminish with decreasing intensity. At very high intensities they are practically proportional to the square of the dose. At lower intensities they are less. A similar response is found by varying the time over which the irradiation is spread, although to prevent too much restitution of the breaks the irradiation must be completed in a relatively short time. For neutrons the yields of two-break aberrations are independent of the intensity and time of exposure and they increase in linear proportion to the dose. This behavior is explained by Catcheside by taking into consideration the two kinds of ionization which are observed with the two types of rays. The roentgen rays ionize by means of electrons. The formation of ions along the track occurs in clusters spaced apart. Only at the end of the track where the electron has lost most of its energy will there be a sufficient number of ions in a given volume to be effective. Thus the two-break aberrations must be the product of at least two separate ionizing particles. The neutron rays ionize by means of protons. Since the ionization from such a large particle is very dense along the entire track, one particle will suffice to produce both the breaks. In other words, the chromosome and chromatid aberrations produced with the low dosages normally employed are predominantly two-hit when induced by roentgen rays and predominantly one-hit when induced by neutron rays.

The gene mutations were studied more extensively on the *Drosophila melanogaster*. It had already been observed by Muller[1] that when adult male flies exposed to radiation were mated to unexposed virgin females a certain proportion of the eggs laid failed to hatch although they had been fertilized. This was ascribed to the fact that changes in the composition of the hereditary particles which were induced by the irradiation produced a dominant lethal mutation in the sperm. Later, an effect on the sex ratio of subsequent generations was also noted.

Catcheside[3] considers the following facts well established with regard to the radiation-induced gene mutations. There is no difference between the spontaneous gene mutations and those induced by the various types of radiations. The genes vary in stability and, as a rule, the less stable ones show the greatest tendency to mutation. When irradiated, the gene directly hit is more apt to be activated but what allelomorph is finally formed remains a matter of chance. There is some evidence that within certain limits back mutations are also possible. The yield of radiation-induced gene mutations is in linear proportion to the dose and independent of the intensity and time of exposure. It is also independent of the natural mutation rate of the particular stock employed. A dose of 3,000 r of roentgen rays produces a mutation rate of 12 per cent which is about 100 times that of the normal rate. This yield is the same from 2.6 Å up throughout the roentgen- and gamma-ray range commonly used but diminishes

for equal doses of other radiations in the order of roentgen rays, neutrons and alpha rays.

These facts indicate that radiation-induced gene mutations are the result of a single ionization. It is assumed that the ionization adds considerable energy to the gene directly hit, rendering it temporarily unstable and thereby altering its mutational potentialities. Not all cells are, however, equally responsive and according to Spear[2] various factors, such as temperature, anesthesia, state of nutrition and degree of germination may influence the mutation rate to a limited extent. From the practical standpoint it is most important that the radiation-induced mutation effect is cumulative in successive generations over an indefinitely long period of time.

A very valuable approach to the study of the genetic effect of the radiations is furnished by Gray[5] who, in considering the ion density as the salient feature of any biologic activity, determined the linear ion density produced by the ionizing particles of the different types of rdaiations. This greatly simplifies the problem since it is not necessary to contrast numerous quality interrelationships but only to consider the ion density produced by a given radiation. Any ionizing particle passing through tissue gradually slows down and consequently produces an increasingly larger number of ions until it is completely arrested. The linear ion density, therefore, increases along the track, depending on the mass of the particle and the length of the path it traverses. The ionizing particles emitted by the various types of radiations are chiefly the electron, proton and alpha particle. The electron represents 1/1850 of the mass of the hydrogen atom carrying one negative charge, the proton has the mass of one carrying one positive charge and the alpha particle is four times the mass of the hydrogen carrying two positive charges. It is evident that if a very swift electron constitutes the ionizing particle, its path in the tissue is much longer and thus the mean linear ion density less, whereas in the case of the bulky alpha particle the entire energy is dissipated along a very short track, and the ionization is very much higher. The magnitude of the biologic effect is to a great extent the result of the mean linear ion density and the proper spatial distribution of the ions irrespective of whether the ionizing particle is an electron, proton or alpha particle.

Gray[5] tabulated the average values of the ion density, given in number of ions per micron of tissue, for the ionizing particles of the different types of radiation. The figures obtained are very illuminating. To quote a few examples, the mean linear ion density produced by the electron of roentgen rays of 1,000 kv. is 15, by the electron of roentgen rays of 200 kv. 80, by the proton of 900 kv. deuterium bombardment of lithium 840, by the proton of 400 kv. deuterium bombardment of deuterium 1,100, by the alpha particle of radon 3,700, by the alpha particle of slow neutron bombardment of boron or lithium 9,000 and by the atomic particles of uranium fission 130,000.

In assaying the ion-density effect on such a fundamental biologic unit as the gene, Gray[5] states that a direct inactivation is accomplished whenever an ionizing particle leaves 2 or 3 ion pairs within the unit. The producton of a chromosome-break, as shown in the experiments with *Tradescantia*, requires about 20 ions formed at one locus within the thread which corresponds to a radiation yielding at least 200 ions per micron of track. Although the phenomena occurring in animal species are more difficult of interpretation, it appears, broadly speaking, that the radiations producing the densest ionizations lead to the greatest biologic effect.

To what extent these observations are applicable to man is not as yet clear. From the point of view of chromosomal changes, it would seem that the more or less universally accepted "tolerance dose" of radiation is sufficient to protect against any ill

[5] Gray, L. H. Comparative studies of the biological effects of x-rays, neutrons and other ionizing radiations. *Brit. Med. Bull.*, 1946, *4*, 11–18.

effects and that thus in this respect there is no immediate danger. However, from the point of view of gene mutation it is a different matter. Because of the cumulative nature of the effect and since the mutational process is permanently irreversible, no "tolerance dose" can be devised to protect against such changes.

Binks[6] raises an interesting question as regards the long-range genetic effects induced by radiations. Most gene mutations are recessive so that the inherited qualities appear only after the mutated gene meets another gene of the same kind. Muller[7] calculated that for independent mutations this would occur after at least 30, but more probably 100 generations, amounting to a latent period of from 750 to 3,000 years. For two genes descended from the same original mutated gene this period would be somewhat longer, extending to about 5,000 years. Binks[6] thinks that this natural mutation rate may be considerably changed if a fraction of the population at one time or another is exposed to larger doses of ionizing radiations. Assuming that all spontaneous gene mutations are the result of ionization due to cosmic rays and to beta and gamma rays from radio-elements in the air, although the fact has not been definitely established, it can be shown that the human race throughout the past ages received 0.07 r per year, or doses up to 5 r during the lifetime of each person. If, for example, from now on 1 per cent of the race should receive on the average 500 r in a lifetime the natural mutation rate would be doubled. Further increase in the proportion of the population irradiated or in the total lifetime dose of the individual would result in a correspondingly higher mutational rate.

In view of the present trend toward a more general use of atomic energy and since the vast majority of the gene mutations are deleterious, the problem acquires great practical significance.

T. LEUCUTIA

[6] Binks, W. Protective methods in radiology. *Brit. Med. Bull.*, 1946, *4*, 58–64.

[7] Muller, H. J. Role played by radiation mutations in mankind. *Science*, 1941, *93*, 438; also *Nature*, London, 1941, *147*, 718–719.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: Netherland Plaza Hotel, Cincinnati, Ohio, Sept. 17–20, 1946.

American College of Radiology
Secretary, Mac F. Cahal, 20 N. Wacker Drive, Chicago 6. Annual meeting: 1947, to be announced.

Section on Radiology, American Medical Association
Secretary, Dr. U. V. Portmann, Cleveland Clinic, Cleveland, Ohio. Annual meeting: 1947, to be announced.

American Radium Society
Secretary, Dr. H. F. Hare, 605 Commonwealth Ave., Boston, Mass. Annual meeting: 1947, to be announced.

Arkansas Radiological Society
Secretary, Dr. Fred Hames, 511 National Bldg., Pine Bluff, Ark. Meets every three months and also at time and place of State Medical Association.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: Palmer House, Chicago, Ill., Dec. 1–6, 1946.

Radiological Section, Baltimore Medical Society
Secretary, Dr. Walter L. Kilby, Baltimore. Meets third Tuesday each month, September to May.

Section on Radiology, California Medical Association
Secretary, Dr. D. R. MacColl, 2007 Wilshire Blvd., Los Angeles 5, Calif.

Radiological Section, Connecticut Medical Society
Secretary, Dr. Max Climan, 242 Trumbull St., Hartford, Conn. Meets bi-monthly on second Thursday, at place selected by Secretary. Annual meeting in May.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. H. W. Ackemann, 321 W. State St., Rockford, Ill.

Radiological Section, Los Angeles Co. Med. Assn.
Secretary, Dr. Roy W. Johnson, 1407 S. Hope St., Los Angeles, Calif. Meets on second Wednesday of each month at the County Society Building.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Brooklyn Roentgen Ray Society
Secretary, Dr. A. H. Levy, 1354 Carroll St., Brooklyn 13, N. Y. Meets monthly on fourth Tuesday, October to April.

Buffalo Radiological Society
Secretary, Dr. Joseph S. Gian-Francheschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months.

Chicago Roentgen Society
Secretary, Dr. F. H. Squire, 1754 W. Congress St., Chicago 12, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. Samuel Brown, 707 Race St., Cincinnati, Ohio. Meets third Tuesday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. Carroll C. Dundon, 11311 Shaker Blvd., Cleveland, Ohio. Meetings at 6:30 P.M. on fourth Monday of each month from October to April.

Dallas-Fort Worth Roentgen Study Club
Secretary, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meets in Dallas on odd months and in Fort Worth on even months, on third Monday, 7:30 P.M.

Denver Radiological Club
Secretary, Dr. A. Page Jackson, Jr., 1612 Tremont Place, Denver, Colo. Meets third Friday of each month at Denver Athletic Club.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

Florida Radiological Society
Secretary, Dr. J. M. Dell, Jr., 333 W. Main St., S., Gainesville, Fla. Meetings in May and November.

Georgia Radiological Society
Secretary, Dr. James J. Clark, 478 Peachtree St., Atlanta, Ga. Meets in November and at annual meeting of Medical Association of Georgia in the spring.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Illinois Radiological Society
Secretary, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

Indiana Roentgen Society
Secretary, Dr. J. A. Campbell, Indiana University Hospitals, Indianapolis 7. Meets annually second Sunday in May.

Iowa X-Ray Club
Secretary, Dr. Arthur W. Erskine, 326 Higley Bldg., Cedar Rapids, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. Special meetings by announcement.

Kentucky Radiological Society
Secretary, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

Long Island Radiological Society
Secretary, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:30 P.M.

Louisiana Radiological Society
Secretary, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

Michigan Association of Roentgenologists
Secretary, Dr. E. M. Shebesta, 1429 David Whitney Bldg., Detroit. Three meetings a year, Fall, Winter, Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave., Milwaukee, Wis. Meets monthly on second Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. Annette T. Stenstrom, 1218 Medical Arts Bldg., Minneapolis, Minn. One meeting a year at time of Minnesota State Medical Association.

Nebraska Radiological Society
Secretary, Dr. D. A. Dowell, Medical Arts Bldg., Omaha, Neb. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. George Levene, Massachusetts Memorial Hospitals, Boston, Mass. Meets monthly on third Friday, Boston Medical Library

NEW HAMPSHIRE ROENTGEN RAY SOCIETY
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

RADIOLOGICAL SOCIETY OF NEW JERSEY
Secretary, Dr. W. H. Seward, Orange Memorial Hospital, Orange, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

NORTH CAROLINA ROENTGEN RAY SOCIETY
Secretary, Dr. Major Fleming, Rocky Mount, N. C.

NORTH DAKOTA RADIOLOGICAL SOCIETY
Secretary, Dr. L. A. Nash, St. John's Hospital, Fargo. Meetings held by announcement.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse. Three meetings a year. January, May, November.

OHIO RADIOLOGICAL SOCIETY
Secretary, Dr. Henry Snow, 1061 Reibold Bldg., Dayton, Ohio. Meets during annual meeting of Ohio State Medical Association.

ORLEANS PARISH RADIOLOGICAL SOCIETY
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

PACIFIC ROENTGEN SOCIETY
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. J. M. Converse, 416 Pine St., Williamsport.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. C. L. Stewart, Jefferson Hospital. Meets first Thursday of each month, October to May, at 8:00 P.M., in Thomson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY
Secretary, Dr. L. M. J. Freedman, 115 South Highland Ave. Meets 6:30 P.M. at Webster Hall Hotel on second Wednesday each month, October to May inclusive.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. Murray P. George, Strong Memorial Hospital. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY
Secretary Dr. A. M. Popma, 220 N. First St., Boise, Idaho. Mid-Summer Conference, August 8, 9, 10, 1946, at Shirley Savoy Hotel, Denver, Colorado.

ST. LOUIS SOCIETY OF RADIOLOGISTS
Secretary, Dr. Edwin C. Ernst, Beaumont Medical Building, St. Louis, Mo. Meets fourth Wednesday of each month, except June, July, August, and September.

SAN DIEGO ROENTGEN SOCIETY
Secretary, Dr. R. F. Niehaus, 1831 Fourth Ave., San Diego, Calif. Meets monthly on first Wednesday at dinner.

SAN FRANCISCO RADIOLOGICAL SOCIETY
Secretary, Dr. Joseph Levitin, 516 Sutter St., San Francisco 2, Calif. Meets monthly on the third Thursday at 7:45 P.M., first six months of the year at Lane Hall, Stanford University Hospital, and second six months at Toland Hall, University of California Hospital.

SHREVEPORT RADIOLOGICAL CLUB
Secretary, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

SOUTH CAROLINA X-RAY SOCIETY
Secretary, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

TENNESSEE RADIOLOGICAL SOCIETY
Secretary, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas.

UNIVERSITY OF MICHIGAN DEPARTMENT OF ROENTGENOLOGY STAFF MEETING
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets every Thursday from 4:00–5:00 P.M., Room 301, Service Memorial Institute.

UTAH STATE RADIOLOGICAL SOCIETY
Secretary, Dr. M. Lowry Allen, Judge Bldg., Salt Lake City 1, Utah. Meets third Wednesday in September, November, January, March and May.

VIRGINIA RADIOLOGICAL SOCIETY
Secretary, Dr. E. L. Flanagan, 116 E. Franklin St., Richmond, Va. Meets annually in October.

WASHINGTON STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Thomas Carlile, 1115 Terry St., Seattle. Meets fourth Monday each month, October through May, College Club, Seattle.

X-RAY STUDY CLUB OF SAN FRANCISCO
Secretary, Dr. J. M. Robinson, University of California Hospital. Meets monthly, third Thursday evening.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGIA Y FISIOTERAPIA
General Secretary, Dr. D. P. Cossio, Marsella No. 11, Mexico, D. F. Meets first Monday of each month.

BRITISH EMPIRE

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE ROENTGEN SOCIETY
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

SECTION OF RADIOLOGY OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

FACULTY OF RADIOLOGISTS
Secretary, Dr. M. H. Jupe, 23 Welbeck St., London, W.1 England.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Keith Hallam, St. George's Hospital, K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to November inclusive.

CANADIAN ASSOCIATION OF RADIOLOGISTS
Secretary, Dr. J. W. McKay, 1620 Cedar Ave., Montreal.

SOCIÉTÉ CANADIENNE-FRANCAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES
Secretary, Dr. Origéne Dufresne, 4120 Ontario St., East, Montreal, P. Q.

SECTION OF RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Anderson, Invercargill, New Zealand. Meets annually.

South America

Sociedad Argentina de Radiologia
Secretary, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

Sociedad Peruana de Radiologia
Secretary, Dr. Julio Bedoya Paredes, Apartado, 2306 Lima, Peru. Meetings held monthly except during January, February and March, at the Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

Continental Europe

Ceskoslovenská společnost pro röntgenologii a radiologii v Praze
Secretary: MUDr. Roman Blána, Praha XII, Korunní 160, Czechoslovakia.

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. Babaiantz, Geneva.
Secretary for German language, Dr. Max Hopf, Effingerstrasse 49, Bern. Meets annually in different cities.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banul Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad: USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 p.m.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

AMERICAN RADIUM SOCIETY

The American Radium Society held its first meeting since 1942 at San Francisco, California, on June 28 and 29, 1946. Dr. W. E. Costolow of Los Angeles, President since 1942, presided until the last session when Dr. Charles L. Martin of Dallas, Texas, was installed. The meeting was held in the Assembly Hall of the Health Building at the Civic Center. Seventy-five members were present but there was constantly an audience of one hundred and fifty.

The Janeway Lecture was given by Dr. Frederick W. O'Brien of Boston. His title was "Radium Treatment of Cancer of the Cervix; a Historical Review." The Henry Harrington Janeway Medal was presented to Dr. O'Brien by the Chairman of the Janeway Lecture Committee, Dr. Douglas Quick of New York, at the banquet in the Fairmont Hotel on Friday evening, June 28, 1946.

The sessions were high-lighted by two significant symposia. Friday afternoon provided a program by the Department of Physics and Radiation of the University of California, Berkeley, arranged by Dr. Robert S. Stone. Hardin B. Jones, Ph.D., told of their search for radioactive compounds of specific localization, such as radioactive phosphorus, radioactive iodine, radioactive strontium and new forms of ionizing radiations from nuclear physics research.

Dr. B. V. A. Low-Beer showed colored slides illustrating skin therapy with radioactive phosphorus captured upon blotting paper. Dr. D. Harold Copp discussed the metabolism of radioactive substances and exhibited autoradiographs of bones harboring radioactive elements. Drs. L. D. Marinelli, F. W. Foote and Alfred Hocker of the Memorial Hospital, New York, presented Histologic and Autoradiographic Studies of Radioactive Iodine in Thyroid Carcinoma. Drs. Robert S. Stone (Manhattan Project) and John H. Lawrence (Cyclotron) provided discussions. These symposia will be published in early issues of the Journal.

Saturday morning found the surgeons using their scalpels upon the radiologists and the radiologists replying with atomic bombs. Subject: Carcinoma of the Cervix. Dr. J. V. Meigs, Boston, and Dr. Daniel G. Morton, San Francisco, promoted radical Wertheim operations for selected cases. Drs. Harry H. Bowing, Mayo Clinic, Ira I. Kaplan and Rieva Rosh, Bellevue Hospital New York, John S. Bouslog, Denver, and George W. Waterman, Providence, upheld the arguments for radiation treatment and principally because the surgeon's criteria of operability applies to so small a percentage of cervical carcinomas. Professional politeness prevailed. The Publication Committee has nearly all of the papers and illustrations in hand and they will be published in forthcoming numbers of this Journal.

The American Radium Society has 204 members. Nineteen members have been added since 1942. They are:

Atwood, Cyril John, M.D., Samuel Merritt Hospital, Oakland, Calif.

Berg, H. Milton, M.D., 221 Fifth St., Bismarck, N. D.

Blanco, Bernado Guzman, M.D., Quinto Cantaclaro, El Rosal Chacao, Estato Mirando, Venezuela.

Catlin, Daniel, M.D., 620 Park Ave., New York 21, N. Y.

Chont, L. K., M.D., Winfield, Kansas.

Chamberlin, George Whitney, M.D., 6th and Spruce Sts., West Reading, Pa.

Crain, Ransome Carter, M.D., 30 N. Michigan Ave., Chicago, Ill.

Ehrlick, Harry E., M.D., 114 Morningside Drive, New York, N. Y.

Emmert, Frederick Victor, M.D., Metropolitan Bldg., St. Louis, Mo.

Guttman, Ruth J., M.D., 147-48 88th Ave., Jamaica 2, N. Y.

Heublein, Gilbert Whipple, M.D., 179 Allyn St., Hartford, Conn.

Knight, William Thomas, M.D., 210 Main St., Hackensack, N. J.

Levi, Leo, M.D., 1200 N. State St., Los Angeles, Calif.

Marinelli, Leonidas D., 444 E. 68th St., New York, N. Y.

Ovalle, Alexander, M.D., 357 E. 68th St., New York, N. Y.

Pierson, John C., M.D., 210 E. 68th St., New York, N. Y.

Scheffey, Lewis Cass, M.D., 255 S. 17th St., Philadelphia, Pa.

Verda, Dominic Joseph, M.D., Barnard Skin and Cancer Hospital, St. Louis, Mo.

Wigby, Palmer Emanuel, 1101 Medical Arts Bldg., Houston, Texas.

There have been 12 deaths and 5 resignations. The deaths are as follows:

Clarkson, Wright, M.D., Medical College of Virginia, Petersburg, Va.

Elward, Joseph E., M.D., 1726 I St. N.W., Washington, D. C.

Kasabach, H. H., M.D., Presbyterian Hospital, New York, N. Y.

Keith, David Y., M.D., 1010 Heyburn Bldg., Louisville, Ky.

Murphy, John T., M.D., 421 Michigan St., Toledo, Ohio.

Taussig, Fred J., M.D., Beaumont Medical Bldg., St. Louis, Mo.

Tyler, Albert F., M.D., 1216 Medical Arts Bldg., Omaha, Neb.

Simpson, Burton T., M.D., 633 N. Oak St., Buffalo, N. Y.

Levin, Isaac, M.D., 57 W. 57th St., New York, N. Y.

Strauss, Abraham, M.D., 25 Prospect Ave. N.W., Cleveland, Ohio.

Soiland, Albert, M.D., 1407 S. Hope St., Los Angeles, Calif.

Stevens, Rollin H., M.D., 1429 Whitney Bldg., Detroit, Mich.

The death of Dr. Marion Truehart of Sterling, Kansas on July 11, 1946, has just been reported.

The new officers are as follows: *President*, Dr. Charles L. Martin, Dallas, Texas; *President-Elect*, Dr. A. N. Arneson, St. Louis, Mo.; *First Vice-President*, Dr. Maurice Lenz, New York, N. Y.; *Second Vice-President*, Dr. Wm. S. MacComb, New York, N. Y.; *Secretary*, Dr. Hugh F. Hare, 605 Commonwealth Ave., Boston 15, Mass.; *Treasurer*, Dr. Leland R. Cowan, Salt Lake City, Utah.

The next annual meeting will be held in June, 1947, in New York or Atlantic City. The definite date and place becomes a function of the Executive Committee now composed of Dr. W. E. Costolow, Los Angeles. Dr. Hayes Martin, New York, and Dr, Frederick W. O'Brien, Boston, Chairman.

EDWARD H. SKINNER

RADIOISOTOPES FROM THE MANHATTAN PROJECT

A detailed announcement on the availability and procurement of pile-produced radioisotopes from the Manhattan Project appears in the June 14, 1946, issue of *Science.**

Tables are included giving pertinent data on the characteristics and the quantities which may be made available of around 100 isotopes and isotopic mixtures. For practical reasons isotopes with a half-life

* Availability of radioactive isotopes. *Science*, June 14, 1946, *103*, 697–705.

less than twelve hours are not considered for distribution. Most of the isotopes are produced by fission or (n,γ) processes. Only four isotopes are produced by the (n,p) process with sufficient yield for distribution. Other processes are either not sufficiently productive or do not occur.

The article emphasizes that (1) present piles were not designed for tracer and therapeutic isotope production, (2) waste plutonium process solutions are not a feasible source for separated fission isotopes, (3) routine production methods and facilities are not yet developed for most isotopes, (4) isotopes which can now be made available are only experimental lots resulting from research and development proceedings, (5) technical problems involved in the irradiation and processing of essential materials has been and will continue to be responsible for the delay in making certain isotopes available by routine production.

Allocation and distribution will be effected on the basis of the general policies, as well as on recommendations regarding specific applications, made by well qualified advisory groups nominated for Manhattan District appointment by the National Academy of Sciences. Charges will be made for materials and services on the basis of "out-of-pocket" operational expenses to the Government necessitated by the non-project production and service program. Costs for construction or rental of major plant facilities and expenses of research and development on isotope production will be assumed by the Project.

All correspondence concerning radioisotope procurement should be addressed to the Isotopes Branch, Research Division, Manhattan District, P. O. Box E, Oak Ridge, Tennessee. Reference to the original article for pertinent details is recommended, however, before instituting inquiries or requests.

AMERICAN COLLEGE OF PHYSICIANS

The American College of Physicians announces its Twenty-eighth Annual Session to be held in Chicago, Illinois, April 28–May 2, 1947. Dr. David P. Barr, New York, is President of the College and will be in charge of the program of General Sessions and Lectures. Dr. LeRoy H. Sloan, Chicago, has been appointed General Chairman, and will be in charge of the program of Hospital Clinics and Panels, as well as local arrangements, and entertainment. Mr. Edward R. Loveland, Executive Secretary of the College, 4200 Pine Street, Philadelphia 4, will have charge of the general management of the session and the technical exhibits.

Other medical societies are urged to note these dates in order that conflicts in meeting dates may be avoided for mutual benefit.

E. R. Loveland
Executive Secretary

PITTSBURGH ROENTGEN SOCIETY

At the last business meeting of the Pittsburgh Roentgen Society, held in The Ruskin, Pittsburgh, the following officers were elected for the coming year: *President*, Harold W. Jacox, M.D., Pittsburgh, Pa.; *Vice-President*, William T. Rice, M.D., Rochester, Pa.; *Secretary-Treasurer*, Lester M. J. Freedman, M.D., Pittsburgh, Pa.

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

Semiologia Clinico-Radiologica de la Tumoraciones del Abdomen. By Dr. F. García Capurro, Prof. Agregado de Radiologia, and Dr. Raúl Piaggio Blanco, Prof. de Clínica Médica, de la Facultad de Medicina de Montevideo. Paper. Pp. 566, with 351 illustrations. Espasa-Calpe Argentina, S. A.—Buenos Aires—México, 1946.

During the past thirty years the diagnostic procedures of abdominal tumors have undergone numerous changes, due chiefly to the continuous development of new roentgen techniques of examination. The authors have assembled all the material available on the subject and, after skillfully co-ordinating the various findings, have compiled an excellent up-to-date treatise of clinical radiological semiology.

The work is divided into two main parts. The first deals with general considerations which are taken up in three chapters. One chapter gives a lengthy discussion of the anatomic, structural and dynamic peculiarities of the abdomen and their importance from the roentgenological standpoint, another the fundamental principles of clinical roentgen diagnosis and the third is a general review of the anatomic modifications provoked by the abdominal tumors.

The second part of the book contains seven additional chapters, dealing with the regional syndromes as follows: IV, tumors which occupy the entire abdomen; V, tumors of the right and left thoraco-abdominal regions; VI, tumors of the region of the left hypochondrium and the left flank; VII, tumors of the region of the right hypochondrium and of the right flank; VIII, tumors of the celiac region; IX, tumors of the right and left iliac fossae, and X, tumors of the hypogastric region and of the pelvis.

Each of the chapters is richly illustrated with typical roentgenograms in various views and with numerous schematic diagrams. A bibliography of 544 articles is appended.

The material is presented in a clear and concise manner. The book is well made and its printing is irreproachable.

T. Leucutia

Kurzwellentherapie. Von Dr. Josef Kowarschik, Professor für physikalische Therapie an der Universität Wien. Third edition. Cloth. Price, $4.25. Pp. 143, with 138 illustrations. Wien: Springer, 1943. J. W. Edwards, Publisher, Ann Arbor, Michigan.

In the foreword to the third edition of his book, the author states that the heated discussions and overproduction of literature regarding short wave diathermy have now quieted down. Many of the highly debatable issues have been completely dropped because in his opinion they represented mostly "pseudo problems." Therefore very few changes and additions were required in this new edition as compared with the previous one.

In the theoretical part he discusses the physics of short electric waves and describes the apparatus and technique of application. This is followed by a brief chapter dealing with the biologic effect of short electric waves. For the radiologist it is interesting to note that the author does not believe in the successful treatment of malignant neoplasms in the human with short electric waves. The only efficient method would be destruction by electrocoagulation. Likewise he does not consider practical the sensitization of tumors by short electric waves preceding irradiation by roentgen rays or radium. In the clinical section he outlines the therapeutic use of the short electric waves in the treatment of diseases affecting the various organs. The concluding chapter is devoted to fever therapy. Each section is supplemented by a selected bibliography and the monographs and books on the subject are compiled at the end of the text. The index is adequate while the illustrations are not too clear. This, however, could probably not be avoided because of wartime conditions and the type of paper used. The author is well known in his field and the book presents, therefore, a good picture of the status of short wave diathermy in Europe about 1940.

Ernst A. Pohle

Röntgenphysik. Von Dr. med. Adolf Liechti, Professor für medizinische Radiologie; Direk-

tor des Röntgeninstitutes der Universität Bern. Mit Beiträgen von Dr. phil. Walter Minder, Technischer Leiter des Institutes der Bernischen Radiumstiftung. Cloth. Price, $11.75. Pp. 308, with 227 illustrations. Wien: Julius Springer, 1939. J. W. Edwards, Publisher, Ann Arbor, Michigan.

This excellent treatise on the physical foundations of roentgen rays was written in 1939 by the radiologist of the University of Bern. It also contains chapters written by W. Minder, physicist and technical director of the Bern Radium Institute. Minder's chapters deal with radiations from radioactive substances, artificial radioactivity and isotopes; measurement of alpha, beta and gamma rays of radium; and non-medical applications of roentgen rays. In the preface Liechti states that "without the most exact knowledge of its physical foundations a beneficial application of radiology in medicine is unthinkable," and he proceeds to furnish such exact knowledge in the text. There are detailed chapters on character and properties of short wave radiations, interrelationships between roentgen rays and the structure of the atom, absorption and scattering of roentgen rays, roentgen-ray generators and roentgen tubes. The author also describes the physical, chemical and biological effects of roentgen rays, roentgen-ray and radium dosimetry, protection against various types of radiation, and finally many special technical procedures such as kymography, cinematography, tomography, and stereoscopy.

The subjects are mostly treated in detail and all are written with authority. A few chapters, such as that on practical dosimetry of roentgen rays and radium, are relatively short and in places inadequate to answer practical questions of the average radiologist. Other chapters, for instance those on atomic physics or on various effects of short wave radiations, present a great deal of information and are in some cases entirely up to date. The book can be highly recommended to radiologists although some knowledge in fundamental physics is required for full appreciation of its contents.

Otto Glasser

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Campbell, James B., and Alexander, Eben, Jr. Eosinophilic granuloma of the skull. *J. Neurosurg.*, Nov., 1944. *1*, 365–370.

Eosinophilic or solitary granuloma of the bone is a granulomatous lesion of bone which affects children and young adults predominantly and more often the male. It is of unknown origin but some authors classify it as the most benign form of a generalized disease process of which Hand-Schüller-Christian disease is the most insidious and chronic and Letterer-Siwe disease the most malignant and severe, the latter occurring in the youngest age groups. At times the various lesions of these diseases are indistinguishable. Jaffe and Lichtenstein feel that the basic disorder is an inflammatory histiocytosis in response to an unknown infectious agent. Clinical manifestations of the three conditions vary and differ greatly save from the roentgenographic viewpoint. The lesion in eosinophilic granuloma is not always solitary; in half of the reported cases the skull has been involved alone or with other bones. No reports of involvement of the skull in other than bones of the vault have been made nor has any involvement of the bones of the hands or feet been reported. The lesions begin in the medullary cavity, erode and expand the cortex. In the skull, erosion occurs inward or outward. The tumor is soft and hemorrhagic composed of aggregates of phagocytes with conspicuous collections of eosinophiles. General symptoms are lacking, local pain is the usual initial complaint. No abnormal laboratory studies have been reported save for mild eosinophilia.

On roentgen examination, the lesions are of varying size, radioluscent and are sharply outlined when they occur in the skull. They must be differentiated from many conditions. Final diagnosis must be made by biopsy. Simple curettage or wide extirpation have been used successfully. Roentgen therapy alone using 1,500 r through two fields in six days has produced satisfactory disappearance of the lesions. Spontaneous resolution of the lesions has been observed. The prognosis is generally good. The case of a twenty-seven year old male with an eosinophilic granuloma of the frontal bone is reported. There was a history of antecedent trauma, which according to some is etiologic. Successful excision was accomplished. —*Leo A. Nash.*

Goodyear, Henry M. Mucocele in frontal and ethmoidal sinuses; simplified surgical treatment. *Ann. Otol., Rhin. & Laryng.*, June, 1944, *53*, 242–245.

A mucocele may occur in any of the nasal accessory sinuses but is more frequently found in the frontal and anterior ethmoid cells, occasionally in the antrum and rarely in the sphenoid sinus.

Etiology. Thomson and Negus state that a mucocele usually occurs with an "obstruction in the outlet of the cavity and it may be caused by blockage and cystic dilatation of a gland."

By a process of slow constant pressure there is a slow absorption of bone, and often the floor of the frontal sinus and the lamina papyracea are destroyed.

Signs and Symptoms. A slight disturbance of vision progressing to a diplopia and often accompanied by a dull headache, which may be increased on movement of the eye, constitutes the first symptom of a mucocele. Thus, these patients usually come first to the attention of the ophthalmologist.

The onset is insidious and usually without pain. Later, the eye is displaced forward, downward and laterally. Diplopia, limited motion of the globe and a variable degree of impaired

vision may be present. Ptosis of the lid, epiphora, and even atrophy of the optic nerve may occur.

There may be "parchment-like" crackling on palpation, and if pulsation is present it means that the posterior wall of the frontal sinus or the floor of the ethmoid, or both, have been absorbed, and the mucocele is lying in contact with the dura mater.

If infection leads to a pyrocele, the swelling may be red and tender and the temperature may be much like that in an acute frontal sinus infection.

Intranasal examination is usually marked by the absence of polypi or pus. The ethmoid bulla may be expanded and lowered.

Roentgen Findings. Early, there are no characteristic roentgenographic findings but with advancement, defects in the orbital and sinus wall occur. The frontal sinus loses its scalloped appearance and the marginal densities become smooth and regular.

Differential Diagnosis. (1) Ostomas are equally insidious and painless in onset but roentgenograms show a sharp demarcated outline of dense bone and in advanced cases there is no "parchment crackling" or pulsation on palpation. (2) Malignant neoplasms are usually much more rapid in growth and usually show redundant, soft, free bleeding tissues in the ethmoid area. (3) Other lesions to be differentiated include gummas, aneurysms, fibromas, angiomas, lymphoid tumors, meningoceles and chronic sinus infections.

Treatment. The author feels that the epithelium lining the mucocele in the frontal sinus can do no harm so he does not remove it in operating upon these lesions.—*Mary Frances Vastine.*

DOWLING, JAMES R. Osteoma of the frontal sinus. *Arch. Otolaryng.*, Feb., 1945, *41*, 99–108.

Definition. Ewing stated that the bony structure of an osteoma of the cranial bones may be ivory-like with solid lamellas and few or no haversian canals, or it may be spongy with cancellous tissue and may contain narrow cavities or spaces.

Incidence. Osteoma of the frontal sinus is by no means a common lesion. The author feels fortunate in having seen osteoma of the frontal sinus in 5 patients within the year 1944 at the Army hospital where he is stationed. Two of the patients were German prisoners of war. The author believes that the higher incidence of the lesion in the Army camps is explained by the fact that osteoma of the frontal sinus as statistics have shown, is chiefly a disease of youth and is more common in males.

Etiology. The frontal sinus is the most frequent site for the development of osteoma of the nose and nasal accessory sinuses. Fetissof after a survey of over 200 cases reported that in 50.7 per cent the osteoma was situated in the frontal sinus, in 40 per cent in the ethmoid labyrinth, in 6.2 per cent in the maxillary sinuses and in 3.1 per cent in the sphenoid sinuses.

Osteoma of the frontal sinus is essentially a lesion of youth and the greater incidence is found between the second and third decades of life.

The cause of osteoma is unknown. In 2 of the author's cases, roentgen study revealed osteitis of the frontal bone for a small area lateral to and above the upper margin of the sinus. This was found surgically to have an appearance of osteitis and it was at this site that the true tumor mass was attached, which suggests the possibility of periosteal inflammatory processes being a strong factor in the causation of the growth.

Pathology. Osteoma is a benign tumor, the growth of which is usually very slow and which is malignant only mechanically.

Morphologically, two types are recognized: the hard, ivory-like eburnated type and the softer, cancellous one. Microscopically, there may be great variations. Ewing stated that at times it is difficult to differentiate certain forms of osteoma from simple hypertrophy of bone.

Symptoms and Diagnosis. In many cases the diagnosis comes only by roentgen examination because of the silent nature of these growths. Dizziness, headaches and deformity are the cardinal symptoms.

The extension of the tumor mass may be in one or in all of three directions, namely, externally through the outer table, internally into the anterior cranial fossa and, lastly, inferiorly in the orbit. The symptoms, then, will depend on the structure on which the pressure, due to the expanse of the growth, is being directed.

Treatment. The only treatment for osteoma of the frontal sinus is surgical removal.—*Mary Frances Vastine.*

PROFANT, H. J. Temporal arteritis. *Ann. Otol., Rhin. & Laryng.*, June, 1944, *53*, 308–325.

Composite Picture of Temporal Arteritis. The

patient, most likely a white woman around sixty years of age or over, complains of severe pain in the temporal region. Her internist will state that the patient has a fever, leukocytosis, general malaise, and sweats. Every known test has been made and found negative. It is hoped that the otolaryngologist will locate a sinusitis which is causing the severe pain and general symptoms. No sinusitis is found and the pain is not relieved by cocainization of the ethmoid and sphenoid areas. In from two to six weeks after this examination a bright red, tortuous swelling of the temporal artery appears. The patient is then informed that she has a "temporal arteritis" which will cause symptoms for many weeks or months and then gradually subside. Thus far, no fatal case has been reported. In the reports, however, eight patients were found to have an associated retinal arteritis with permanent diminution of vision or complete blindness.

Summary of the Literature. In practically all of these case reports the question of a sinusitis arose. In over 50 per cent, painful mastication at the onset is mentioned. This indicates that the inflammation of the temporal artery extended down or, in fact, may have originated at, or below, the temporomandibular joint region.

The youngest patient was fifty-five years of age and the oldest eighty. The average age was sixty-seven and there were three times as many women as men. All were of the white race.

The shortest duration was one month and the longest twenty months; the average was nine months.

The age level and prolonged course with recovery are distinctive clinical features of a temporal arteritis.

Diagnosis and Treatment. In the author's 2 cases a diagnosis was made by the clinical picture in which a tender, red, tortuous, nodular temporal artery appeared. In the first case this occurred five weeks after the onset of the temporal pain, and in the second case, two weeks. The marked nodular swelling of the inflamed artery could be observed at a distance of 10 feet from the patient.

Sulfonamides were tried and discontinued. The author did not feel that a resection of a segment of the artery had therapeutic value. His 2 patients made a complete and spontaneous recovery. However, 1 of these patients had a severe acute exacerbation of the temporal arteritis following extraction of three infected teeth. This episode would verify the opinion of some previous writers that a focus of infection is the causative factor.

Pathology. The microscopic pathology in temporal arteritis is essentially the same as in periarteritis nodosa. (However, the clinical picture is entirely different.)—*Mary Frances Vastine.*

Danelius, Gerhard. Value of the axial projection of the petrous bone in the diagnosis of chronic mastoiditis and cholesteatoma. *Radiology*, Nov., 1944, *43*, 492–498.

Good views of the structures in or near the mastoid antrum and tympanic cavity, which are most frequently involved in chronic mastoiditis, are rarely obtained by the routine projections. The author therefore describes in detail and illustrates with roentgenograms an axial projection introduced some twenty years ago by Ernst G. Mayer of Vienna. It is rather difficult technically and distorts all the petrous bone except the mastoid antrum, attic, tympanic cavity and the wall of the posterior auditory canal and so has not become popular in the United States. The author gives this technical description in the hope of stimulating interest in this very valuable projection. It gives a surprising wealth of detail in regard to the antrum, attic, tympanic cavity and wall of the posterior auditory canal, "as if a curtain had been lifted from them."

It is not possible to differentiate solely on roentgen evidence between an undeveloped, diploic, undiseased mastoid and a chronic, sclerotic mastoid, but if the ear is diseased clinically a chronic sclerotic mastoiditis may be assumed. When a cholesteatoma has reached a considerable size it can be diagnosed during a quiescent stage by its smooth, regular outline. But during an acute attack this outline becomes blurred, making it difficult to differentiate between such a cholesteatoma and a granulomatous, purulent, enlarged antrum. But the presence, size and exact position of the cavity in the petrous bone can be reported. A postoperative defect may resemble a cholesteatoma but the history of operation should differentiate between them.

In the typical pathological case the findings are so characteristic that the percentage of roentgen errors is very low after the examiner has had experience in analyzing these roentgenograms.—*Audrey G. Morgan.*

Kautz, Friedrich G., and Schwartz, Irving. Intra-ocular calcium shadows; choroid ossification. *Radiology*, Nov., 1944, *43*, 486–491.

Few cases of calcification in the eyeball have been demonstrated roentgenologically although it has long been known to ophthalmologists from clinical examination and dissection of the enucleated eye. The literature of the subject is reviewed and 7 cases of intraocular calcification described and illustrated with roentgenograms. Shadows caused by intraocular calcium can be differentiated easily from those caused by foreign bodies, incomplete removal of metallic dust and residual thorotrast following roentgen examination of the orbit.

The roentgenogram usually shows a shrunken orbit, with a dense ovoid, circular or semicircular calcium shadow in the center of it. The shadow is not strictly homogeneous; it occupies the region of the lens and extends into the posterior part of the eyeball more frequently than into the anterior part. Pathologic examination shows a shell-like ossification of the choroid and lens. The majority of the authors' patients were middle aged and most of them had a history of foreign body injury of the eye. In some cases there were no symptoms and the calcification was found incidentally on roentgenography of the sinus.

There are three methods of demonstrating these intraocular calcifications—by a posteroanterior projection of the orbit, by an additional lateral view such as is used for foreign body localization and by a bone-free technique which eliminates the surrounding bones. The authors have had satisfactory results from all three methods. The orbit should be examined in any roentgen study of the facial bones, skull and sinuses.—*Audrey G. Morgan.*

Little, Samuel C., and Pascucci, Lucien M. Basilar impression and associated deformities—case report. *New York State J. Med.*, Mar. 15, 1945, *45*, 638–642.

There are a number of anomalies and deformities of the skull and upper part of the spine which, though comparatively rare, are frequent enough to be of importance in differential diagnosis from other organic lesions in this region. Their cause is not yet known but it is probable they are all variants of one abnormal process of development. They include the Arnold-Chiari deformity, in which displacement of parts of the cerebellum takes place into the upper vertebral canal and the fourth ventricle is elongated so that it opens into the spinal subarachnoid space below the level of the foramen magnum; or there may be downward herniation of the whole cerebellum into a cervical spina bifida and meningocele. Ordinary roentgenograms of the head and neck of patients with this deformity, if uncomplicated, do not show any abnormality but myelographic studies may show obstruction of the upper cervical canal and foramen magnum by the herniated cerebellum and medulla.

The Klippel-Feil deformity usually consists of a defect of the atlas, a cervical spina bifida and fusion of some of the cervical vertebrae. In spina bifida with its congenital cleft of the vertebral column the spinal cord remains in the sacral or lower lumbar region and may be injured by lumbar puncture; there is degeneration of the cord as a result of stretching and true syringomyelia-like cavities, not due to hydrocephalus, appear in the cervical cord. The fixation of the cord is not necessarily accompanied by any bone defect that can be demonstrated roentgenologically. Basilar impression is a deformity of the base of the skull in which the foramen magnum is distorted and seems to have been pushed up into the posterior fossa. The atlas may be assimilated into the occipital bone, the lower part of the odontoid process encroaching on the cervical portion of the spinal canal and the upper part projecting into the foramen magnum. This condition is often associated with the Arnold-Chiari deformity, the Klippel-Feil syndrome, spina bifida, syringomyelia and other manifestations of spinal dysraphia.

Roentgenograms of these conditions are given and a case described in a soldier twenty-seven years of age who was admitted to hospital complaining of weakness of the left arm and leg. A roentgenogram showed basilar impression. A suboccipital decompression operation was performed and the patient's condition improved greatly. The dura was not opened so it is not known whether there was also an Arnold-Chiari deformity.—*Audrey G. Morgan.*

Olsen, Axel, and Horrax, Gilbert. The symptomatology of acoustic tumors with special reference to atypical features. *J. Neurosurg.*, Nov., 1944, *1*, 371–378.

The symptomatology of tumors of the cerebellopontine angle, particularly the acoustic

neuromas, as summarized by Cushing, includes auditory and labyrinthine disturbances, occipitofrontal pains and occipital discomfort, cerebellar incoordination and instability, evidence of adjacent cranial nerve involvement, indications of increasing intracranial pressure, dysarthria and dysphagia, and cerebellar crises, and death in progressive order. Olsen and Horrax, reviewing 42 cases of acoustic neuromas found essential agreement with the above. In addition, certain features were noted such as the absence of tinnitus in 38 per cent of cases and while it was noted about the same time as deafness it preceded hearing loss in only 4 cases. Headache is less significant of increased pressure than pressure on the fifth cranial nerve. Nystagmus was present in all. Caloric examination was not made in 9 patients but an absent response on the involved side was noted in all undergoing this procedure, and the authors stress its value since it may obviate ventriculography or lumbar puncture. In 15 cases examined roentgenologically, 9 showed positive findings and in no case was plain roentgen examination the final diagnostic criterion. In 8 cases, ventriculography was used to determine the type of approach or to differentiate tumor from some other lesion.—*Leo A. Nash.*

NECK AND CHEST

Mason, Malcolm W. Photofluorography for chest surveys. *Radiology*, Nov., 1944, *43*, 499–503.

It is of very great importance in the control of tuberculosis to detect the early unsuspected cases so as to place them under treatment and prevent the spread of the disease. This can now be accomplished to a very great degree by photofluorography.

There are four methods of conducting mass surveys for tuberculosis. The first is by the use of the standard 14×17 inch film, the second by the use of 14×17 inch paper films, the third by the photofluorographic method, using 4×5 inch films with stereoscopic views. The author believes this is the most adequate. The fourth method is by the use of 35 mm. films. This method is also adequate and reliable and the cost is very low. This was the method used by the author at the Great Lakes Training station. He gives a report of results in 400,263 chest examinations at the Naval Training Station at Great Lakes. In a total of 41,616 examinations made with the 35 mm. film there were 16 errors which were errors in interpretation and not due to the method as such. Since the beginning of the survey 6 patients with negative diagnoses have been hospitalized with active tuberculosis. This may have been due to overlooking the lesion on account of its smallness and the smallness of the film or it may have been due to the fact that the disease developed between the time of the examination and that of hospitalization.

There is no doubt that these examinations have been of great value to the government in keeping men out of the service who were not able to go in. It is estimated that by these 400,263 examinations the government was saved more than $22,000,000.

Though the method with the 4×5 inch film is more reliable than that with the 35 mm. film the latter is reliable enough for practical purposes and is more rapid and less expensive.

It is believed that if this method of mass examination could be extended to the whole population tuberculosis might be practically eliminated.—*Audrey G. Morgan.*

Alpern, Algernon N., and Benjamin, Julien E. The induction film as an aid in appraising subsequent pulmonary lesions. *Radiology*, Dec., 1944, *43*, 548–562.

The most important problem in tuberculosis in the Army, as well as in civilian life, is the detection of early slight lesions that are not causing symptoms. On January 1, 1941, the Army assumed full responsibility for the roentgen-ray service at induction centers and the Surgeon General's Office issued an order that chest examinations include a roentgenogram with special attention to the detection of tuberculosis. All roentgenograms made at the time of induction are filed for permanent record and are of great value in studying the subsequent history of the cases. At United States Army Induction Center No. 6, disqualifying lesions were found in 1.2 to 1.3 per cent of cases.

Cases are considered acceptable for military service when they have healed primary intrathoracic tuberculosis lesions of small size. The sizes of such lesions are fixed arbitrarily and the fact that an inductee is passed does not necessarily mean that he will not have tuberculosis later. Cases that might remain quiescent in civilian life may be reactivated by the worry and over-fatigue of military training.

From January 1, 1942 to January 1, 1943, 4,019 patients were admitted to Lovell General

Hospital. Of these, 122, or 3.03 per cent, were admitted directly to the tuberculosis ward for proved or suspected tuberculosis; among these there were 14 cases of non-pulmonary tuberculosis. Of the 108 remaining patients 23, or 21.3 per cent, were admitted solely on the basis of routine roentgen examination of the chest. In 11 of these cases the tuberculosis was proved to be active, and in 6 this could be proved only by serial roentgen examinations. The laboratory tests were negative.

Induction roentgenograms were available from the Veterans' Bureau or civilian hospitals in 21 cases. In 1 patient with a negative induction roentgenogram tuberculosis developed nine months later. Thirteen patients had demonstrable lesions at the time of induction. Four of these had been considered acceptable under the rule defining acceptability. In 2 of these cases the lesions proved to be active and showed progression when the patients were hospitalized. In the other 2 they had remained stationary. These examples show the value of roentgenograms taken at induction but this value depends on the quality of the photography and the care with which the roentgenograms are interpreted. Among the 3,897 patients admitted to hospital with other than tuberculous conditions 26 were found on roentgen examination to have asymptomatic pulmonary tuberculosis. During the past two years there have been an increasing number of atypical pneumonias. These are very hard to differentiate from tuberculosis, and prolonged observation until they are resolved is often necessary.

The so-called lordotic view is often valuable in the demonstration of small lesions at the apex which are partly hidden by the clavicles or bones of the thorax. Illustrative roentgenograms are given.—*Audrey G. Morgan.*

MOEHLIG, ROBERT C., and ULCH, HAROLD W. Multiple parathyroid adenomata; three operative explorations with removal of two tumors. *Harper Hosp. Bull.*, Dec., 1944, *2*, 41–49.

Multiple adenomas of the parathyroid are by no means uncommon. A case is described in a man of sixty-two admitted to Harper Hospital November 13, 1938, with frequency and burning on urination, nausea and vomiting after meals and stiffness of the knees, ankles, shoulders and elbows. He had had tuberculosis twenty-five years before with complete arrest after a year of treatment. Bladder stones had been removed twenty-one years before.

Roentgenograms showed considerable demineralization of the bones such as is seen in parathyroid disease. From this and the clinical symptoms a diagnosis of parathyroid tumor was made and operation performed on February 8. A light brown tumor which proved on examination to be a parathyroid adenoma was removed from the lower pole of the thyroid gland. The right side was not examined. The clinical symptoms as well as the hypercalcemia and high serum phosphatase persisted and on February 28 an exploratory operation was performed which did not reveal any further tumors. But as weakness and dyspnea increased a third operation was performed on July 12. A yellowish-brown tumor was found on the left side that proved to be a parathyroid body intermingled with remains of a thymus. The patient died three days later of heart failure.

The question is considered as to whether the high caloric and high calcium diet given for tuberculosis twenty-five years before had overburdened the parathyroids and whether parathyroidism in a subclinical form was present at the time of the removal of the bladder stones twenty-one years before. There were no clinical signs of parathyroidism at the time.

This case illustrates the fact that careful examination should be made on both sides even if a large tumor is found on only one side. Special skill is necessary in operating on the parathyroids, even greater than that ordinarily required for removal of the thyroid. The problems to be considered are those of the anatomy and physiology of the parathyroids rather than those of the regional anatomy of the neck.—*Audrey G. Morgan.*

MOORE, NORMAN S., WIGHTMAN, HENRY B., and SHOWACRE, EDWARD C. Primary atypical pneumonia. I. A statistical report of 196 cases. *New York State J. Med.*, Apr. 15, 1944, *44*, 869–872.

Eighty-six cases of this new disease were reported from Cornell University in 1939 under the name of acute interstitial pneumonitis. It is known by various names and is seen chiefly in young adults of military age. It has assumed such importance that the Surgeon General has appointed a special commission to study it.

This article discusses 196 cases seen at Cornell University from 1937 to 1941. The average age was 20.4 years; 84 per cent were in

males; 73 per cent of the cases occurred between July and January; 58 per cent of the cases were mild, 30 per cent moderate and 11 per cent severe. There were no deaths. In 10 per cent of the cases the onset was sudden, within a few hours, but in the majority of cases it was gradual. Cough was the most constant symptom in hospital, occurring in 90 per cent of cases. The hospital fever averaged 5.94 days; there was pleurisy in 20 cases. An irregular, peaked temperature curve was seen in all moderate and severe cases; the left lower lobe alone was involved in 43 per cent of the cases, the right lower lobe alone in 66 per cent. The prognosis was good but there was prolonged disability which rendered the disease important from the military point of view.

Treatment in general was symptomatic. The author believes that sulfonamide treatment is indicated though it does not have any direct effect on the disease itself. A failure to react to sulfonamides helps in the differential diagnosis of a typical pneumonia and the sulfonamides even in low dosage help to control the pathologic bacteria of the respiratory tract and so to reduce the subsequent complications of the disease.—*Audrey G. Morgan.*

Showacre, Edward C., Wightman, Henry B., and Moore, Norman S. Primary atypical pneumonia. II. Observations of radiographic patterns. *New York State J. Med.*, Apr. 15, 1944, *44*, 872–879.

The authors first saw primary atypical pneumonia at Cornell University in 1935. In the nine years since then they have made roentgen studies of a number of epidemics and give roentgenograms showing the typical appearances seen. Generally there are no roentgen signs until thirty-six hours or more after the first beginning of symptoms. The shadows generally appear within from thirty-six to seventy-two hours after the beginning of symptoms and spread in area and become denser or confluent. The common pattern which occurs in about half the cases shows increased density of the hilum, swelling of the larger trunk branch shadows and the presence of finer branch shadows which are not visible normally. These linear shadows are soon obscured but not obliterated by a veil of haze which extends in a fan shape from the hilum into the adjacent lung. The fine nodular type is essentially the preceding type plus scattered denser, soft nodular areas. In the reverse fan type, the fan previously described has its apex at the periphery and the fan spreads toward the hilum. In the hilar type there is increased density of the hilar structures on one or both sides without involvement of the lung fields. Lobar consolidation was seen in only 1 per cent of the cases. Apparent atelectasis, manifested by lobe contraction and elevation of the diaphragm was rarely seen.

The three varieties of spread seen were the continuous, the unit and the explosive types, which are described. There were two types of clearing. The fan types became less dense and disappeared within a week from beginning resolution. All of the nodular and some of the homogeneous density types gradually lost their soft appearance and a more organized type of infiltrate appeared. A case first seen during this stage might be considered one of chronic lung disease. Complete resolution usually required from one to two weeks. The longest time seen from the beginning of resolution to complete clearing was ten weeks.

While the roentgen image in this disease is characteristic is is not diagnostic in the majority of cases. Similar patterns may be seen in inflammatory reactions from various irritants, such as virus, rickettsia, protozoa, fungi, bacteria, chemical fumes or mechanical agents. In order to make a correct diagnosis, the history, clinical findings and bacteriological and roentgenographic evidence must all be taken into consideration. The disease is best differentiated from other lung diseases by serial roentgenograms.—*Audrey G. Morgan.*

Elkeles, A., and Glynn, L. E. Serial roentgenograms of the chest in periarteritis nodosa as an aid to diagnosis, with notes on the pathology of the pulmonary lesions. *Brit. J. Radiol.*, Dec., 1944, *17*, 368–373.

Periarteritis probably represents an extreme hyperergic response of the vascular system to foreign serum and other sensitizing antigens, such as bacteria and their products. The lungs are not as frequently involved as some other organs so few roentgen examinations of the chest have been recorded. But the author believes that serial roentgenograms of the chest may aid in diagnosis of this disease, in which diagnosis is very difficult, and he therefore presents descriptions and serial roentgenograms of 2 cases, one of which was followed up for five months.

The roentgenograms showed patchy infiltra-

tions in both upper lobes which may have been caused by small infarctions. The hilar shadows were enlarged and of increased density. The pulmonary vessels appeared as dense wavy streaks gradually fading towards the periphery. The patchy infiltrations suggested tuberculosis but the fact that they disappeared without leaving scarring argued against this interpretation. In later examinations there were enlarged dense hilar shadows interspersed with areas of intense density almost suggestive of aneurysmal dilatation of the pulmonary vessels with thrombus formation. There was fibrosis and diffuse mottling in the adjacent mesenchymal structures. In a late stage of the disease pleural effusion developed first on the left side and then on both sides.

In the pathological notes a wide rim of perivascular scar tissue is described around the smaller arteries. There was complete loss in places of the internal elasticity of these vessels and thickening of the intima resulting in some areas in almost complete obliteration of the lumens of the vessels by cellular granulation tissue. No acute lesions of periarteritis nodosa were seen.

Specific changes of periarteritis nodosa are seen in the lungs in only about 30 per cent of the autopsy cases, though they must be much more frequent during life, as evidenced by experimental work on rabbits. Five out of 12 rabbits in which the disease was produced by inducing hypersensitivity to foreign serum showed typical vascular lesions in the lungs.—*Audrey G. Morgan.*

DUNNER, LASAR, and HERMON, R. Further observations on lung disease in boiler-scalers. *Brit. J. Radiol.*, Dec., 1944, *17*, 355–358.

In a previous paper (*Brit. J. Radiol.*, Oct., 1943, p. 287) one of the authors said that the opacities in lung disease in boiler-scalers were uniformly distributed in both lungs. In the study of the 5 cases reported in this paper they found that this is not true but that the lesions may be variously distributed. They believe that in all cases which show even minor evidences of fibrosis, increased striation or reticulation, a careful study of the history should be made for possible pre-existing occupational pneumoconiosis, even if the disease for which the patient is admitted is tuberculosis or carcinoma. Regular routine roentgen examinations should be made also. There was a history of occupational disease before the development of the tuberculosis or carcinoma in all of the 5 cases reported. Roentgenograms at various stages of the disease are given. Men in the service may be given compensation for tuberculosis when, as a matter of fact, it should be given for a pre-existing occupational pneumoconiosis.—*Audrey G. Morgan.*

PENHA GODOY D'ALAMBERT, J., and PEREIRA DA SILVA, C. Adenocarcinoma esquirroso da mama com metástases ósseas generalizadas. (Scirrhous adenocarcinoma of the breast with generalized bone metastases.) *Hospital*, Rio de Janeiro, May, 1944, *25*, 715–727.

A case is described in a woman of forty-three admitted to the Juqueri Hospital, São Paulo, Brazil in October, 1942. About six months before she had had severe genital hemorrhage caused by chronic endometritis and was very anemic on admission. In addition to the hard tumor of the right breast found on clinical examination, which proved to be a scirrhous adenocarcinoma, roentgen examination showed generalized bone metastases. The bone lesions progressed steadily until finally the external wall of the frontal bone was eroded. During the latter days of her life the right eye protruded and was sightless. She died July 9, 1943. Autopsy showed metastases also in the meninges, brain, kidneys, spleen, retroperitoneal lymph glands, pleura, pericardium and right eyeball.

The authors review the literature of this subject and also that of other forms of tumor that commonly cause bone metastases, such as tumors of the prostate and thyroid and hypernephroma. Cases like the one described are very rare and the authors believe that the bone metastases may have been initiated by the anemia which the patient had in the beginning and which produced a site of least resistance in the bone marrow. They study the frequency of bone metastases in general and consider the circulatory and biophysical factors which may be involved in their localization.—*Audrey G. Morgan.*

ADAIR, FRANK E. CRAVER, LLOYD F., and HERRMANN, JULIAN B. Hodgkin's disease of the breast. *Surg., Gynec. & Obst.*, Feb., 1945, *80*, 205–210.

A noteworthy contribution to the understanding and treatment of Hodgkin's disease in recent years has been the recognition of primary

localized types. Gilbert in 1939 stated that "primary digestive, pulmonary, and bony lesions without involvement of the peripheral nodes are known." There is evidence that the disease in this form is amenable to surgery in some locations. Slaughter has reported good results with this mode of therapy in cases in which the disease was apparently confined to localized lymph node groups. Recently Bini has reviewed the literature on primary gastrointestinal lymphogranuloma. The results in many of those patients treated by surgery were encouraging.

Hodgkin's disease is most uncommon. Symmers, for example, gives its incidence as 0.04 per cent of the approximately 50,000 annual admissions to Bellevue Hospital. An unusual manifestation of this disease is involvement of the breast. A review of the literature discloses only 8 reported cases.

During the period of 1932 to 1942, 406 patients with Hodgkin's disease were seen at Memorial Hospital, New York. Among this group there were 5 individuals, or 1.25 per cent, who exhibited specific breast lesions of Hodgkin's disease. Within the same time interval 3,901 cases of carcinoma of the breast were seen.

A study of these patients with Hodgkin's disease of the breast as well as those reported in the literature reveals that:

1. The average age was 22.5 years.

2. The tumor was situated in the right breast in 8 cases and in the left in three.

3. There was 1 male in the series and 1 negro (female), the latter fact being noteworthy since Symmers and others have remarked on the rarity of the disease in this race.

4. Hodgkin's disease of the breast may manifest itself as a primary condition or as a lesion secondary to generalized lymphogranulomatosis. On that basis the following classification of lymphogranuloma of the breast is proposed: (1) primary; (2) secondary including (a) discrete and (b) diffuse.

5. Since the mode of spread of this disease is not well understood the condition may be considered primary in the breast only if there is no other evidence of the disease elsewhere in the body.

6. The importance of establishing a diagnosis of primary mammary lymphogranuloma lies in the fact that this condition may be amenable to surgical treatment.

7. Hodgkin's disease tends to infiltrate the structures in the vicinity of the original lesion. Desjardins writes, "In some cases lymphoblastoma has a tendency to infiltrate the tissues outside of the lymph nodes and become quite extensive. Thus an entire breast and the superficial tissues of the corresponding half of the thorax may become densely infiltrated." If the axillary nodes are involved the disease is almost certainly generalized and, consequently, unsuitable for surgery.

8. Of the 4 examples of primary breast involvement in this collected series only 3 were followed until death, and of these, 2 were from the authors' clinic. The average duration of life after the onset of the disease in these 3 patients was four years and one month. In the 2 cases of secondary discrete involvement in the series the life duration of the patients after the initial appearance of the disease averaged five years and five months. The life expectancy in Hodgkin's disease is about two years and eight months. Thus it is seen that in the cases being discussed there was a definite increase in the life expectancy of the individuals with either primary or secondary breast involvement.

9. It may be that there is an increased life expectation in those cases that develop breast lesions. In primary involvement the explanation for this relative longevity may be that the disease remains localized in the breast for a considerable period before it appears in other locations. In the instances of secondary disease the explanation may be that the involvement of the breast under these circumstances is a late manifestation which occurs in the relatively long lived cases. In this it may be comparable to the abdominal manifestation of Hodgkin's disease which has been found to be a development late in the course of the disease, and a phenomenon occurring in those patients with relative longevity.

10. Students of the subject have been at a loss for an adequate explanation of breast involvement in the lymphomas. Symmers believes that lymphoid tissue must be present to act as a nidus. The authors are in agreement with this concept. The breast is adequately supplied with intralobular and periductal lymphoid infiltrates and some lymph nodes. These may be the foci for the localization of the lymphomas in this organ.—*Mary Frances Vastine.*

Nelson, W. E., and Smith, L. W. Generalized obstructive emphysema in infants. *J. Pediat.*, Jan., 1945, *26*, 36–55.

An expiratory type of dyspnea associated with generalized emphysema is common in infancy and childhood. Many varied etiological agents can produce a common picture. The obstruction is mainly in the terminal bronchioles. Obstruction to expiration which is usually more marked than obstruction to inspiration leads to emphysema. Complete obstruction leads to atelectasis. The picture clinically may resemble an attack of asthma but in obstructive emphysema the dyspnea persists for a week or more. Features which are common to all cases, no matter what the etiology, are an increased respiratory rate, decreased respiratory excursions, utilization of the accessory muscles of respiration with suprasternal retraction, varying degrees of cyanosis, hyperresonant percussion note, and characteristic roentgen findings.

On the roentgenograms the diaphragms are depressed and flattened, the intercostal spaces are widened, the lung fields are hyperaerated but of even greater value is the fluoroscopic picture of depressed, relatively immobile diaphragms and the relatively constant degree of aeration of the lungs in both inspiration and expiration.

In the authors' experience the above picture of obstructive emphysema is usually seen in a self-limited entity similar to the virus or atypical pneumonia of adults, but it may be seen in a variety of other conditions. Among these are aspiration of amniotic contents during birth, cystic fibrosis of the pancreas, atypical, bronchopneumonia, laryngotracheobronchitis, miliary tuberculosis, aspiration of zinc stearate powder, and chronic passive congestion secondary to congenital heart disease. Nelson and Smith present illustrative cases of obstructive emphysema resulting from each of these conditions. In some instances the obstruction is due to aspiration of foreign material and in others to edema and exudation from mucosal irritation.

The initial obstruction is probably of the "by-pass valve" type which permits free passage of air in both directions but this later changes to the "check-valve" type in which air enters the lungs freely but is then trapped and obstructive emphysema results. Should the obstruction become complete, the "stop-valve" type, atelectasis results.

In the differential diagnosis of conditions causing obstructive emphysema the age may be of help. If the symptoms are due to aspiration of amniotic fluid they should be present at or shortly after birth. Symptoms associated with cystic fibrosis of the pancreas appear during the first weeks of life. Acute infections are more apt to occur after the child has left the nursery.

For treatment of obstructive emphysema associated with aspiration of amniotic fluid the authors suggest bronchoscopic aspiration or intratracheal aspiration by a catheter passed through a laryngoscope. Oxygen and carbon dioxide inhalations are also of value.—*R. M. Harvey.*

FABER, H. K., HOPE, J. W., and ROBINSON, F. L. Chronic stridor in early life due to persistent right aortic arch. *J. Pediat.*, Feb., 1945, *26*, 128–137.

Most physicians are not aware that persistent right aortic arch can be a cause of chronic stridor in infancy and childhood. The diagnosis has been made more frequently since the publication of the paper of Assmann in 1924. The authors were able to find only 4 cases reported in the literature which were diagnosed during life in infants. They wish to emphasize the fact that the diagnosis was not suspected in any of the 4 although stridor was a predominant symptom. They present 2 cases of their own.

The first patient was a two months old white male admitted to the hospital for noisy breathing which had been present since birth. The noise was more conspicuous when the child was awake and crying. Laryngoscopy was negative. The correct diagnosis was not made on this admission but on a subsequent admission one year later, following a roentgen diagnosis of a midline thoracic tumor mass. Fluoroscopic examination showed an upper mediastinal shadow to the right of the spine with definite pulsations. No aortic knob was visible to the left of the spine. An esophagogram showed anterior and left-sided displacement of the esophagus at the level of the 4th and 5th thoracic vertebrae. A diagnosis of right aortic arch was made. The shadow of the descending aorta could be seen passing to the right of the spine.

In the second case, a two and a half year old male child, additional confirmation of the diagnosis was provided by kymographic studies, which showed vigorous pulsations in the right upper mediastinum and absence of pulsations on the left.

Dysphagia and stridor in these cases is due to compression of the esophagus by the right aortic arch, passing behind the esophagus on its

way toward the descending aorta. Symptoms may be absent or the stridor may be so severe as to cause retraction of the suprasternal notch, rib cage and epigastrium and cyanosis.

The diagnosis during life is by roentgen examination alone. The characteristic roentgen findings are anterior displacement of the esophagus at the level of the bifurcation of the trachea, a filling defect in the esophagus in the anterior view and left-sided displacement of the esophagus. The aortic knob is absent on the left and may be prominent on the right. The authors emphasize the value of the kymogram. Ordinary physical examination is practically worthless.

In the differential diagnosis mediastinal tumor, aortic aneurysm and thymic tumors must be considered. Probably many cases of stridor which have been diagnosed in the past as due to thymic hyperplasia have actually been due to right aortic arch. The latter diagnosis should be excluded before the former is considered. The condition of right-sided aortic arch is compatible with long living but respiratory infections must be guarded against.—*R. M. Harvey.*

Lavenstein, A. F. Ingestion of kerosene complicated by pneumonia, pneumothorax, pneumopericardium, and subcutaneous emphysema. *J. Pediat.*, April, 1945, *26*, 395–400.

There have been frequent reports on the accidental ingestion of kerosene by children. The seriousness of kerosene ingestion results from the associated pulmonary complications which have been proved to be due to aspiration of kerosene either directly or from regurgitation from the stomach into the lungs. The author reports a case of pneumonia, pneumothorax, pneumopericardium and subcutaneous emphysema following kerosene ingestion.

Lavenstein's patient was a two year old Negress who was admitted to the hospital after swallowing an unknown quantity of kerosene. Physical examination revealed a toxic child whose heart and lungs appeared essentially normal. She showed moderate acidosis and dehydration which was combatted with intravenous sodium lactate and 5 per cent glucose in normal salt solution. Two days following admission the child became dyspneic, her respirations rose to 88 per minute and she appeared extremely ill. Physical examination at this time showed an impaired percussion note at the right base, coarse râles over the right lung and crepitation over the anterior chest wall and supraclavicular areas.

Roentgen examination showed density at the right base due to consolidation or atelectasis, "stringy" infiltration throughout the remaining lung fields and subcutaneous emphysema. Roentgenoscopy later the same day showed bilateral pneumothoraces, mediastinal emphysema, and pneumopericardium. Following administration of oxygen and sulfonamides the patient made a gradual recovery.

The author offers the following explanation for the development of the pneumothorax, mediastinal emphysema, pneumopericardium and subcutaneous emphysema. Kerosene aspiration is followed by a diffuse pneumonitis associated with areas of bronchopneumonia or atelectasis. Surrounding these are areas of compensatory emphysema. This leads to ruptured alveoli from over-distention and escape of air through the perivascular sheaths into the mediastinum, thence into the pleural cavity, and by way of the fascial planes into the subcutaneous tissues of the neck.—*R. M. Harvey.*

Kassowitz, K. E. Healed asymptomatic miliary tuberculosis. *J. Pediat.*, Jan., 1945, *26*, 56–60.

Before the advent of the roentgen ray, miliary tuberculosis was regarded as an almost invariably fatal disease. Recently subclinical and practically asymptomatic cases have been reported with evenly disseminated miliary tubercles throughout both lungs. Leibermeister classified benign miliary tuberculosis in three groups: (1) cases having an early benign course but later dying of the disease; (2) cases in which complete clearing of the lung occurs, and (3) cases in which demonstrable miliary tuberculosis persists in the lungs.

The author reports a case of a child born in 1931 with a family history negative for tuberculosis. He was negative to 0.1 mg. of old tuberculin at the age of thirteen months. The child was not seen again until the age of eight when he had meningitic involvement with an upper respiratory infection. He made a complete recovery and following this attack showed a 1 plus reaction to 0.01 mg. of old tuberculin. A chest roentgenogram at this time showed a questionable soft calcification in the left hilum but was otherwise negative. Routine chest roentgenograms were negative until October, 1941, thirteen months after his last previous check-up at which time a chest roentgenogram

showed bilateral tracheobronchial adenitis, with dense calcifications, and miliary calcified nodules evenly distributed throughout both lung fields. The patient had been in good health in the interim since his last visit. Stomach washings inoculated into a guinea pig did not produce tuberculosis in the pig. Subsequent chest examination showed no change in the chest roentgenograms and the child remained asymptomatic for two and a half years after the original chest film showing miliary lung nodules. Roentgenograms are reproduced to show the sequence of changes.

In the differential diagnosis tuberculoid pneumoconiosis, lymphosarcomatosis, coccidiosis and other fungoid conditions must be considered.—*R. M. Harvey.*

HARDY, J. B., and KENDIG, E. L., JR. Tuberculous pleurisy with effusion in infancy. *J. Pediat.*, Feb., 1945, *26*, 138–148.

A study was made of a group of 393 children under the age of two years infected with tuberculosis, at the Tuberculosis Clinic of the Harriet Lane Hospital. Thirteen, or 3.3 per cent, of this group had a tuberculous pleurisy with effusion. Diagnostic criteria were: (1) demonstration of tubercle bacilli by culture or guinea pig inoculation of the pleural fluid; (2) calcification in the pleura after disappearance of the fluid, or (3) a positive tuberculin test, the presence of pleurisy with effusion, and the subsequent course of the disease. Thirty-two other children in this series had a demonstrable fibrinous pleurisy by roentgen examination.

The age incidence for the development of the effusion varied from ten to twenty-eight months. The effusions were almost three times as common in colored children as compared with white. All of the children had a demonstrable underlying tuberculous process; 7 a primary complex, all of whom made an uneventful recovery, and 6 had mediastinal tuberculosis complicated by tuberculous pneumonia. Two of the latter group developed cavitation and required pneumothraces. The majority of the effusions lasted less than six months. Eight of the 13 cases recovered with calcification of the primary complex, 2 developed the adult type of tuberculosis, 1 dying of renal tuberculosis years later, and the other 3 died of tuberculous meningitis. All of the deaths were in Negro patients. Eleven of the cases had a known exposure to sputum positive tuberculosis.

The thirteen cases are summarized and roentgenograms of 9 of the cases are reproduced.—*R. M. Harvey.*

NEUHOF, HAROLD. Acute putrid abscess of the lung. *Surg., Gynec. & Obst.*, April, 1945, *80*, 351–354.

This paper is based on the 172 cases of acute putrid abscess of the lung which have been subjected to operation in the past sixteen years, at the Mount Sinai Hospital, New York.

Pathology of Acute Putrid Pulmonary Abscess.

1. Omitting the rare metastatic form all putrid pulmonary abscesses can be assumed to be due to aspiration of infective material. There is set up a gangrenous bronchopneumonia in the involved bronchopulmonary segment.

2. Liquefaction occurs in a few days and an abscess is formed within a week or ten days of the onset of the pulmonary infection. The abscess is usually fully developed within two weeks.

3. The abscess is single and spherical, is always situated superficially within the pulmonary lobe, and abuts on the thoracic parietes.

4. The abscess cavity is well demarcated from the beginning. Its contents are foul air, pus, and debris, and, in the early stages, fragments of gangrenous lung. The interior of the cavity is smooth at a surprisingly early stage. The orifices of one or more bronchi are present.

5. Well defined pleural adhesions are present over the abscess which usually seal off effectively the free pleural space. These adhesions are visceroparietal in the great majority of cases, bind the abscess to the thoracic parietes, and render it readily accessible for safe surgical entry. In a small proportion of cases the abscess faces a fissure, the diaphragm, the mediastinum, or the pericardium.

Classification. Toward the end of, or after, six weeks, additional lesions usually appear; multiocularity, spread of infection by spill-over, interstitial pneumonitis, fibrosis, bronchiectasis. Accordingly it was decided to term all abscess *acute* if of less than six weeks' duration and *chronic* if over the age.

Indications for Operation. (1) Imperative—patients with hyperacute manifestations (severe toxicity), unusually large abscesses which appear to be on the verge of invading or have already invaded the pleura. (2) Elective—cases of small abscesses which remain stationary or increase in size after a period of observation,

abscesses in which cavities drain poorly (roentgen evidence), patients with sustained fever or intensely fetid sputum, cases in which there is diabetes.

Roentgenologic Applications.

1. The application of roentgenology to the diagnosis and especially to the exact localization of an acute abscess represents the essential basis for correct surgical management.

2. After it was learned that films revealed the characteristic feature of pulmonary abscess (cavity with a fluid level) in no more than half the cases, that only a circumscribed area of dense "pneumonic" infiltration existed in some cases, and that areas of rarefaction might or might not appear in the midst of such infiltration during observation, it became evident that the diagnosis of pulmonary abscess often could not be made on films alone. On the other hand, studies of films always made possible a precise localization of the abscess.

3. In order to have precise localization, a mixture of methylene blue and iodized oil is injected into the intercostal musculature at the assumed place (often determined fluoroscopically) of contact between the abscess and the thoracic wall. Films in appropriate positions are taken and the relationship of the iodized oil to the abscess is seen. The methylene blue in the musculature is exposed at operation in order to locate the situation of the radiopaque oil which was injected.

Operative Procedure. The development of the one stage operative procedure was based on the realization that a pulmonary abscess is characterized by a superficial position with overlying adhesions and that the essential pathology is constant. Thus, when adhesions are not encountered one can be quite sure that the site of surgical approach is not correct.

In brief, this procedure consists in exposure of pleural adhesions by a limited excision of a segment of the rib, incision through adhesions at their densest portion, disclosure of the abscess by aspiration, its uprooting by excision of the thin compressed shell of overlying lung, and the visualization and gauze tamponade of the abscess cavity and all its recesses.—*Mary Frances Vastine.*

Rees-Jones, G. F. Cystic disease in an azygos lobe with phrenic nerve paresis. *Brit. J. Radiol.*, Dec., 1944, *17*, 386.

An airman of twenty-four complained of general debility and dry cough. A roentgenogram showed an azygos lobe and fluoroscopy showed that about two-thirds of the right diaphragm was paralyzed. Tomography showed that the azygos lobe was made up almost entirely of cysts. There was no evidence that they were infected as the patient had no sputum. Bronchography showed the cysts well filled. Shortly after this examination the patient coughed up a considerable amount of sputum, which was not examined.

The paresis of the phrenic nerve was probably due to the fact that the nerve in its passage through the upper thorax was involved in the same anomaly of development that caused the infolding of the pleura that produced the azygos lobe. The bronchus to the lobe was stenotic, which was probably the cause of the cysts.—*Audrey G. Morgan.*

Guyer, R. B. Case of bronchial carcinoma presenting diagnostic difficulties. *Brit. J. Radiol.*, Dec., 1944, *17*, 380–382.

A soldier forty-one years of age was sent for examination complaining of loss of weight and persistent cough. Roentgen examination showed a dense opacity in the right apex just below the clavicle which suggested tuberculosis. A swelling of the 8th left rib should have suggested the true condition but a biopsy later was diagnosed as sarcoma. He was given roentgen treatment and the swelling on the rib completely disappeared. When he returned some weeks later the 3d lumbar vertebra had been destroyed and the patient's general condition had deteriorated rapidly. Roentgen examination showed massive consolidation of the upper right lung and a diagnosis of bronchogenic carcinoma was made. The course of the disease was rapid and the patient died in a little more than three months after his first admission to hospital.

Autopsy showed a small tumor originating from the eparterial bronchus. Histopathological examination showed that it had developed from the bronchial epithelium which had undergone metaplasia to a stratified type. The tumor was a very malignant anaplastic epithelioma.—*Audrey G. Morgan.*

Laff, Herman I., and Neubuerger, Karl T. Bronchial adenoma with metastasis. *Arch. Otolaryng.*, Dec. 1944, *40*, 487–493.

The authors report 2 cases of so-called bronchial adenoma in which the neoplasm presented

different histologic patterns. In one the rare cylindromatous form existed for thirteen and a half years and terminated with metastasis to the opposite lung. In the second the more common solid form of the neoplasm was at first mistaken for "oat cell carcinoma." Correlated clinical and pathologic studies may serve to confirm the impression that the cylindromatous form is potentially more malignant than the more common form. The term "bronchial carcinoid"—already employed by some authors—might be adopted in preference to "bronchial adenoma."

Diagnosis and Treatment. Bronchial adenoma is commonly found in one of the main bronchi, is slow growing and produces severe cough, pain in the chest, wheezing dyspnea and frequently severe hemoptyses. Prolonged bronchial obstruction ultimately causes extensive damage to the lung distal to the stenosis, resulting in atelectasis, drowned lung, pneumonitis, bronchiectasis, pulmonary abscess and empyema.

Endoscopic treatment may result in cure when the neoplasm exists only as a pedunculated polyp. This rarely occurs; in most instances bronchial adenoma is sessile and has extrabronchial extensions, frequently larger than the endobronchial portions.

It appears that total eradication is dependent on intrathoracic surgical intervention (lobectomy or pneumonectomy). Many apparently permanent cures have been effected in these cases.

In contrast to the age incidence of the more common bronchogenic carcinoma, the adenoma endangers chiefly the female sex and the younger age groups, between twenty and fifty years.

Pathogenesis. The authors wish to stress the potentially malignant character of neoplasms diagnosed as bronchial adenoma, manifested in their invasive growth (extrabronchial extension) and their ability to produce late metastases. Their histologically "benign" appearance is not incompatible with biologically malignant behavior.—*Mary Frances Vastine.*

TAYLOR, HENRY K., and MCGOVERN, TERESA. Angiocardiography; anatomy of the heart in health and disease. *Radiology*, Oct., 1944, *43*, 364–372.

Angiocardiography has helped to settle many problems in regard to the anatomy and pathology of the heart since it was first introduced by Robb and Weiss in 1928. The authors have studied 120 cases by this method, 18 of them normal and the others showing various kinds and degrees of abnormality. Cardiograms and diagrammatic sketches of normal and various pathological conditions are given. They found that the normal heart outline differs somewhat from that usually described. Detailed descriptions of the appearance in the various positions are given. This method is of value in studying congenital anomalies of the heart and great vessels and makes it possible to differentiate between vascular and non-vascular lesions of the mediastinum. The middle segment of the heart is formed in the majority of cases by the left pulmonary artery. Less frequently it is formed by the pulmonary aorta and occasionally by both. The descending aorta may also form a part of the border of the middle segment of the heart. The ventricular conus lies deep, within the heart shadow and never forms a part of the border.

In the posteroanterior position the right heart does not occupy more than half the silhouette of the heart. The ascending aorta normally does not form part of the right border of the heart which is made up of the superior vena cava and the right auricle, with the inferior vena cava taking part sometimes in the formation of the lowermost part. In the right anterior oblique position the left auricle and ventricle form a figure 8, lying in an almost horizontal plane, with the auricular shadow posterior to and on a slightly higher level than that of the left. The left ventricle occupies the greater part of the heart outline and helps form the border anteriorly.

Two non-opacified areas were seen in the heart outline. The one at the lower part of the heart outline in the posteroanterior position is believed to be the inferior vena cava while the one at the junction of the middle heart segment and the base of the left ventricle is thought to be a solid part of the left auricular appendage. —*Audrey G. Morgan.*

MAYO, OSCAR N., and SPENCER, JACK. Cardiospasm. *Radiology*, Oct. 1944, *43*, 383–385.

Cardiospasm can usually be diagnosed clinically from the epigastric pain or discomfort, dysphagia and regurgitation of food. But sometimes clinical symptoms are so slight that diagnosis cannot be made without roentgen examination.

Such a case is reported in a Negro twenty-six

years of age admitted to the Station Hospital, Fort Bliss, Texas, for gonorrhea but also complaining of an acute upper respiratory infection which he had had for four days. For this reason pneumonia was suspected and a roentgen examination made. It showed changes in the right lower lung field which were thought to be those of pneumonia, and a mass in the mediastinum which extended toward the right. Roentgenoscopic examination with barium showed a dilated eosphagus with obstruction at the cardia, which established the diagnosis of cardiospasm. Inhalation of amyl nitrite relaxed the cardia partially and some of the barium passed into the stomach. This is an important differential sign from carcinoma, in which the cardia does not relax. Later examination showed that the focus in the lower lung field was an aspiration pneumonitis from having aspirated some of the overflowing contents of the esophagus.

It is very necessary in obscure conditions in the chest to make a roentgen examination with the esophagus filled with barium.—*Audrey G. Morgan.*

ABDOMEN

Vaughan, W. W., and Eichwald, Max. Priodax; contrast medium for cholecystography. *Radiology*, Dec., 1944, *43*, 578–581.

Priodax has been found a useful contrast medium in cholecystography and superior in some respects to tetraiodophenolphthalein. It is freer from by-effects such as nausea, diarrhea and vomiting and the gallbladder is not obscured by the presence of the medium in the region of the hepatic flexure of the colon as it often is on the use of tetraiodophenolphthalein.

The authors discuss the use of priodax in 163 unselected cases. The drug was given by the double dose, the divided dose and the single dose methods. The latter was found preferable and is now used as a matter of routine.

A series of 63 cases was analyzed for operative confirmation of roentgen findings. Thirty-nine were normal and 24 showed evidence of gallbladder disease. In 22 of the latter cases the cholecystographic findings were confirmed by operation.—*Audrey G. Morgan.*

Johnstone, A. S. Stellate translucencies as a sign of gall-stones. *Brit. J. Radiol.*, Nov., 1944, *17*, 352–353.

A case is described in a woman of twenty-eight who had symptoms of gallstones. The roentgenogram of the gallbladder region showed a number of slight translucencies surrounded by faint calcified margins and shaped like facetted gallstones. In the center of each there was a sharp stellate translucency. Operation showed multiple gallstones.

This condition is very rare. This is the first case recorded in about 6,000 cholecystographies. The central fissuring of gallstones which must take place before air can be admitted to their interior is probably caused by shrinking of the albuminoid matrix of the soft center. The outer walls are rigid and do not give so that a a central cavity is formed.—*Audrey G. Morgan.*

Scott, Virgil. Abdominal aneurysms. Am. J. Syph., Gonor. & Ven. Dis., Nov., 1944, *28*, 682–710.

In a review of 96 patients with abdominal aneurysms from the records of the Johns Hopkins Hospital, Scott found 58.3 per cent to be syphilitic, 20 per cent arteriosclerotic, 18.8 per cent mycotic, 1 per cent due to periarteritis nodosa and 1 per cent tuberculous (contiguous infection). There is a wide variation in the distribution of the etiological agents in comparative studies from various centers. Syphilis has been reported as the cause of abdominal aneurysm from as low as 8.8 per cent to as high as 75 per cent. Syphilitic aneurysms occurred chiefly in the upper abdominal aorta, 80 per cent were above the renal artery and all the arterior sclerotic aneurysms were in the lower aorta or beyond the bifurcation. Mycotic aneurysms occurred chiefly in the smaller abdominal vessels as the mesenteric or hepatic artery. Multiple aneurysms occurred in 14.4 per cent of the syphilitic group, 30 per cent of the arteriosclerotic group and in 16.5 per cent of the mycotic group. Seventy-five per cent of the syphilitic aneurysms occurred under fifty years of age while arterosclerotic aneurysms were found in the older age groups predominantly. Because of the relation to bacterial endocarditis, the peak incidence of mycotic aneurysms was in the lowest age group. About two-thirds of the abdominal aneurysms were in Negroes, 89 per cent were in males. Arteriosclerotic aneurysms were found in white patients only. Pain is the outstanding symptom which with bone erosion is quite severe at night. Nausea and paresthesias may occur. The majority of arteriosclerotic aneurysms were symptomless. In 75 per cent of the syphilitic group an expansile pulsation was detected whereas mass was present in only 25 per cent of the arterio-

sclerotic group of which but 2 of 5 revealed pulsation. A mass in relation to a large vessel or a very vascular tumor may produce the effect of pulsation which may be mistaken for aneurysm. The syphilitic aneurysms were the largest of the three main types. Saccular lesions predominated in each group, the highest percentage of fusiform or diffuse aneurysms occurred in the arteriosclerotic group. A high incidence of involvement of the heart and aorta was present in the syphilitic group contrary to teaching. Rupture occurred earlier in the mycotic group due to necrosis. The demonstration of calcification in the wall of an aneurysm together with bone erosion, usually between the 11th thoracic body and the 2nd lumbar body is diagnostic. The prognosis is grave but may be variable, one patient surviving twenty-eight years.—*Leo A. Nash.*

BROWN, SAMUEL, FLACHS, KAMILLO, and WASSERMAN, PHILIP. Aberrant pancreatic tumor in the duodenal wall. *Radiology*, Oct., 1944, *43*, 385–386.

Aberrant pancreatic tissue rarely causes tumor but when it does the tumor is usually in the duodenum. Such a case is described in a woman of sixty-four admitted to the Department of Roentgenology of the Jewish Hospital, Cincinnati, complaining of pain in the abdomen, loss of appetite, "sour stomach" and frequent vomiting for two months. A complete roentgen examination of the gastrointestinal tract was made. The gallbladder failed to fill and there were no dense shadows suggestive of gallstones. The stomach and bulb of the duodenum were normal in size and shape. In the right lateral position they were found in normal position with relation to the surrounding structures but the duodenum contained gas with only a little of the contrast mixture irregularly distributed through it. Most of the barium had been vomited shortly after the examination. There was no obstruction or deformity in the colon. A probable diagnosis of lesion of the gallbladder was made.

Re-examination ten days later showed uniform filling of the gallbladder of only moderate density. But in the right lumbar region was a large oval pocket containing gas, apparently in the duodenum. A second barium meal examination showed the stomach normal in size but the duodenum greatly dilated and ending abruptly at the inferior angle. In the right lateral position there was a deformity in the outline of the ascending part of the duodenum which encroached on its lumen and apparently caused stenosis. A diagnosis of new growth in the duodenum was made. This diagnosis was confirmed on operation and microscopic examination showed that the tumor originated from pancreatic tissue. As there was no tumor in the pancreas itself it was concluded that the tumor originated from aberrant pancreatic tissue in the wall of the duodenum.—*Audrey G. Morgan.*

JACOBS, E. A., CULVER, G. J., and KOENIG, E. C. Roentgenologic aspects of retroperitoneal perforations of the duodenum. *Radiology*, Dec., 1944, *43*, 563–571.

Perforations of the duodenum into the free peritoneal cavity are easily diagnosed and treated but in retroperitoneal perforation the mortality still remains at 90 per cent. These perforations may result from peptic ulcer but are usually caused by injuries such as kicks or blows on the abdomen, crushing between heavy objects or being run over by a vehicle. Clinical symptoms do not usually appear until extravasation has occurred and it is then too late for treatment. Infection has occurred and death results from retroperitoneal cellulitis and necrosis.

It should be easy, however, to make a diagnosis by roentgen examination within an hour or two of the injury. In spite of this fact, however, roentgen diagnosis has been reported previously in only 3 cases. The use of barium or bismuth salts is contraindicated in perforations of the gastrointestinal tract but the air passing through the rupture in the intestine produces an emphysema which can be demonstrated roentgenologically. A chart is given showing the routes usually followed by air passing through a retroperitoneal rupture of the duodenum.

Proper positioning of the patient is absolutely necessary in examining for this condition. Roentgenograms of the abdomen should be made with the patient in the supine, the upright, left lateral decubitus and lateral positions. Stereoscopic roentgenograms may help in localizing the emphysema. The patient should be told to lie on his left side so that air rather than intestinal contents will pass through the opening.

Two cases of traumatic retroperitoneal perforation of the duodenum are described and illustrated with roentgenograms. In both cases

the trauma was the result of a blow on the back, not the abdomen. The roentgenogram was negative in the first case because of the absence of emphysema but the condition was demonstrated on autopsy. In the second case, the patient recovered without surgery so the nature of the lesion was not absolutely proved but the roentgenographic evidence was quite conclusive.—*Audrey G. Morgan.*

Pomeranz, Raphael, Grady, Hugh G., Peelen, Matthew, and Magnes, Max. Spontaneous cholecystoduodenal fistula in a patient with primary hepatoma of the liver. *Radiology*, Dec., 1944, *43*, 582–587.

A corporal, forty-two years of age, a native of South America, was admitted to Winter General Hospital, Topeka, Kansas, on October 15, 1943, by transfer from a station hospital which he had entered a month previously complaining of persistent dull epigastric pain. He had a feeling of obstruction in the stomach but no vomiting. No history or tarry or clay-colored stools. In 1938 he had had an attack of severe epigastric pain which was relieved by an injection and he had been well since up to the time of his admission to the hospital. He had chills alternating with fever. Tentative diagnosis based on roentgen examination September 25, diffuse gastric carcinoma or syphilis of the stomach.

On admission to the Winter Hospital there was rigidity of the upper part of the right rectus muscle and a tender mass below the xiphoid process on both sides. Red blood cells 4,300,000, white cells 10,000, hemoglobin 13.8 gm. Occult blood in the feces, total gastric acidity 49.0, free hydrochloric acid 45.0, no lactic acid. Roentgen examination showed a spontaneous fistula between the upper part of the duodenum and the gallbladder; there was a possible obstructive stone in the cystic duct. The liver was enlarged about 2 inches below the costal margin.

Operation showed multiple nodules of the liver, microscopic examination of which proved adenocarcinoma of the liver. Both lobes of the liver were adherent to the diaphragm, and the lesser curvature of the stomach was adherent to the lower surface of the left lobe of the liver.

Autopsy showed the lower two-thirds of the left lobe of the liver and the median part of the right lobe replaced by a solid mass of tumor tissue while there were tumor nodules throughout the rest of the liver. There was a single calculus in the gallbladder and one in the common duct. There was secondary adenocarcinoma of both adrenals and degeneration of the myocardium.

The incidence of spontaneous biliary fistulae is about 0.4 per cent; they are generally caused by chronic glalbladder disease, as in this case. The spontaneous biliary fistula evidently preceded the tumor of the liver; it is not known how much the chronic infection of the gallbladder contributed to the development of the carcinoma of the liver; probably the two processes were independent. Microscopic examination showed no cirrhosis, which is associated with 85 per cent of hepatomas. The incidence of primary carcinoma of the liver is also low, probably about 0.2 per cent and the association of these two unusual conditions is extremely rare. The authors have not found any other case reported in the literature.

The carcinoma of the liver was only suspected clinically but there was one roentgen sign that should have suggested it, namely a "selective" barium residue at the lesser curvature of the fundus of the stomach near the left lobe of the liver.—*Audrey G. Morgan.*

Shirley, Amos R. An unusual gastrocolic communication. *Radiology*, Dec., 1944, *43*, 588–590.

A white man forty-eight years of age who had been well previously had an attack of vomiting following a heavy meal with severe pain and slight distention of the abdomen. He appeared undernourished and underweight but said he had lost no weight before the attack two weeks previously Roentgen examination of the digestive tract showed an unusual communication between the stomach and colon about 11 cm. long lying in the left half of the abdomen. The upper part of the tract was triangular and measured 7 cm. across and 4 cm. in depth. The rest of the tract which passed into the transverse colon had a maximum width of about 3.5 cm. It seemed possible that the triangular part of the tract was a part of the stomach separated from the rest of the organ by a carcinoma. There was no palpable mass such as would be expected from a large carcinoma but there was firmness on pressure over the abdomen. No part of the communicating tract showed a mucosal pattern like that of the stomach, small intestine or colon.

On the forty-eight hour roentgenogram the deposition of barium in the tract was the same

as that in the stomach, supporting the theory that at least the upper triangular part of the tract was a part of the stomach. This was confirmed on operation. A tumor 10×12 cm. in diameter was found in the stomach, involving the greater curvature, the gastrocolic omentum and the middle part of the transverse colon. The gastrocolic fistula which had been demonstrated roentgenologically lay within this tumor. The appearance of segmentation in the roentgenogram had been caused by a broad, ring-like band of carcinomatous tissue running parallel to the curvature. Inside it lay that section of the communicating tract which connected the large upper part of the stomach with the smaller and lower triangular part.

The patient died the day of the operation one month after the first appearance of symptoms. As he had had no symptoms until two weeks before examination it is impossible to say how long the carcinoma had been developing. —*Audrey G. Morgan.*

BERSON, H. LEWIS, and BERGER, LOUIS. Multiple carcinomas of the large intestine. *Surg. Gynec. & Obst.*, Jan., 1945, *80*, 75–84.

This investigation is limited to cancers in the colon and rectum as encountered during the years 1934 to 1943 inclusive. The summary and conclusions are:

Summary.

1. The presence of a carcinoma does not confer immunity against the appearance of other primary cancers in the large intestine.

2. A predisposition or susceptibility to cancer is more important in the multiple carcinomas than chance, age or sex.

3. Sixty-six cases of double and 6 patients with three cancers were collected from the literature since 1932. To these are added 13 patients with two cancers and 3 patients with three malignant growths.

4. Polyps were present in 25 per cent of single cancer patients and in 37.5 per cent of those with multiple carcinomas. In 67 per cent of the latter group, malignant degeneration had taken place.

5. The frequency of multiple cancers in our series was found to be 4.8 per cent.

6. There were 11 cases in men and 5 in women.

Conclusions.

1. Multiple cancers can occur in the large intestine either synchronously or metachronously.

2. The prognosis in cancer resections is influenced by the presence of a second malignant lesion in that if overlooked death of the patient may ensue because of the continued growth of the lesion.

3. Any patient who has had one carcinoma removed should be observed carefully and repeatedly for the possible development of a second new growth. Grindley very aptly stated, "A patient with one cancer is a good subject for the development of a second, and is more susceptible than one who is cancer free." —*Mary Frances Vastine.*

FISHBACK, H. R., JR. Meckel's diverticulum strangulated in an inguinal hernia. *Harper Hosp. Bull.*, Dec., 1944, *2*, 60–64.

From 1912 to the present time only 14 cases of strangulation of a Meckel's diverticulum in an inguinal hernia have been reported. The case described here is the fifteenth. A review of the literature and a bibliography of the subject are given.

The patient was a woman of forty-seven admitted to Harper Hospital August 23, 1944, complaining of anorexia, loss of weight and a "draining rupture" of three weeks' duration. She had been in good health until 1938 when she had a pelvic operation performed. When she left the hospital there was a small protruding mass in the perineum which she called a rupture. On August 7, 1944, the rupture broke through the skin in four places, three in the perineum and one to the right and above the right pubic tubercle. On several occasions after 1938 she had had blood in the stools.

Physical examination on admission showed transverse enlargement of the heart with systolic and diastolic murmurs over the mitral area and three draining sinuses in the perineum and one above the right pubic tubercle. She was put on soft diet and symptomatic treatment but became distended and cyanotic with a terminal rise of rectal temperature to 101° F. and she died on September 14, 1944.

Autopsy showed fluid in the abdominal and thoracic cavities. A mass protruded from the opening in the skin above the right pubic tubercle. Thirty-four inches from the ileocecal valve a Meckel's diverticulum had herniated into the inguinal canal and become strangulated. A diagrammatic drawing of the hernia and diverticulum is given. A growth on the

pulmonic valve proved to be an aseptic one superimposed on a hemangioma of the base of the valve.—*Audrey G. Morgan.*

GYNECOLOGY AND OBSTETRICS

Banner, Edward A., Hunt, Arthur B., and Dixon, Claude F. Pregnancy associated with carcinoma of the large intestine. *Surg. Gynec. & Obst.*, Feb., 1945, *80*, 211–216.

Up until 1943, there have appeared in the literature a total of 62 cases in which carcinoma of the intestine has complicated pregnancy. This report adds 7 additional cases of pregnancy associated with carcinoma of the large bowel. The findings may be summarized as follows:

1. In the 62 cases encountered in the review of the literature, the maternal mortality was 63 per cent in the 41 cases in which the maternal outcome was known. The gross fetal mortality was 50 per cent in cases in which surgical treatment was employed.

2. The maternal mortality and the corrected fetal mortality were both 14.3 per cent in the 7 cases reported by the authors.

3. The age and weight of the patients as well as the concentration of hemoglobin in the blood and the sedimentation rate of the erythrocytes are of little value in arriving at a diagnosis of carcinoma of the intestinal tract in pregnancy.

4. Some symptoms of carcinoma of the colon or rectum, such as nausea, vomiting and constipation, are thought to be commonly associated with pregnancy. Proctoscopic and roentgenologic examination of the colon should be performed in all cases in which pregnant women complain of unexplained constipation, diarrhea, or bloody discharge from the lower part of the bowel. Nausea and vomiting, especially in the latter half of the pregnancy, demand the exclusion of carcinoma of the colon.

5. On reviewing the literature one is impressed by the ease with which delivery takes place through the pelvis even after removal of the lower part of the sigmoid colon and rectum. —*Mary Frances Vastine.*

Lynch, Robert, and Dockerty, Malcolm B. Spread of uterine and ovarian carcinoma with special reference to the role of the fallopian tube. *Surg., Gynec. & Obst.*, Jan., 1945. *80*, 60–65.

This paper is based on a study of 113 cases of carcinoma of the uterus or ovary, or of both of these organs, that were observed at the Mayo Clinic in eleven and one-half years, namely from January 1, 1929, to June 30, 1940, inclusive.

Anatomic studies have demonstrated the existence of interconnecting links in the lymphatic drainage of the uterus, tubes and ovaries. The inescapable conclusion from this study is that carcinoma may spread from the uterus to the ovaries, or vice versa. In the majority of cases the spread is by direct extension or by lymphatic extension or by lymphatic permeation alone or combined, and frequently, with simultaneous involvement of the fallopian tube as an intermediary stage in the process. In a minority of these cases viable malignant cells may spread through the lumen of the fallopian tube, usually without being implanted on its mucosa.

Summary.

1. In 113 cases of operative uterine and ovarian carcinoma the malignant process had invaded other pelvic structures.

2. In 51, or 44 per cent, of the cases the lesion arose in the ovary and involved the fallopian tube, and in 12 cases it arose primarily in the fundus of the uterus and involved a fallopian tube.

3. In 20, or 18 per cent, of the cases the lesion involved the ovaries, endometrium, and tubes. In 12 of these cases the primary site of the lesion was in the ovary, in 6 cases it was in the uterine fundus, and in 2 cases the primary site was doubtful.

4. In 30 cases ovarian and endometrial carcinoma coexisted without evidence of tubal lesion. The primary growth was uterine in 12 cases and ovarian in 13. In 5 cases the site of the primary lesion was doubtful and the possibility of two independent sites of origin could not be excluded entirely.

5. Approximately 6 per cent of ovarian carcinomas metastasized to the endometrium and examination of curetted material occasionally revealed the extrauterine site of the primary growth.

6. Conversely, about 4 per cent of operable carcinomas of the uterine fundus eventually involved the ovary or ovaries. In both circumstances the fallopian tube seemed to act as the intermediary host to the malignant cells. In only 1.4 per cent of cases did it serve in the capacity of a passive conduit, and in only 0.4 per cent was the direction of the flow reversed,

namely, from uterus to ovary. From a practical standpoint, therefore, little risk was indicated for the production of ovarian or abdominal implantation in curetting a uterus which is the site of a malignant lesion, prior to the insertion of radium. In only a few cases was evidence found that carcinoma cells became implanted on tubal mucosa in the extension of malignant lesions of the ovary or fundus of the uterus.—*Mary Frances Vastine.*

INGRAHAM, CLARENCE B., BLACK, WILLIAM C., and RUTLEDGE, ENID K. Relationship of granulosa-cell tumors of the ovary to endometrial carcinoma. *Am. J. Obst. & Gynec.*, Dec., 1944, *48*, 760–773.

Granulosa and theca cell tumors may be associated with much excessive and abnormal endometrial hyperplasia that a histologic pattern indistinguishable from adenocarcinoma results. Two cases of granulosa cell tumor and one of theca cell tumor of the ovary associated with adenocarcinoma of the corpus uteri are reported by the authors.

In each of these cases the histologic appearance of the endometrium is sufficiently hyperplastic and atypical to be classed as adenocarcinoma.

Endometrial hyperplasia which duplicates the histologic features of adenocarcinoma of the uterine body may accompany granuloma cell tumors of the ovary. In the author's 1 case, the endocervix was also hyperplastic. There is no histologic criterion which enables one to distinguish this condition from adenocarcinoma, yet in one of Stohr's cases, that of a woman before the menopause, a normal menstrual cycle was resumed six weeks following the removal of the granulosa cell tumor. Curettage after eight weeks showed a typical early secretory phase of the endometrium, and the patient remained well with a normal menstrual history for five years. This case is remarkable in that only the ovarian tumor was removed. The estrogenic influence of the remaining ovary was not abolished and yet the endometrial hyperplasia regressed. This case provides evidence of the direct relationship between the ovarian tumor and the endometrial hyperplasia, considered by Stohr as adenocarcinoma, and in addition, indicates that such proliferation is reversible.

It remains a question as to whether or not a true carcinoma of the endometrium would regress if all abnormal sources of estrogenic hormones could be removed. According to Taylor, three sources of an excessive supply or abnormal type of estrogenic hormone in the human may be considered: from follicles, as in follicular (functional) cysts; from ovarian tumors, as in granulosa cell and theca cell tumors; and from an extra-ovarian source. In the third instance, the presence of estrogenic substances in male urine and in the urine of females after the menopause and after castration may be cited. Extra-ovarian estrogenic substances may be formed in both sexes in the metabolism of cholesterol and bile acids and chemically related carcinogenic substances may likewise originate in the same manner.

From the report of Jones and Brewer, it appears that normally functioning ovaries do not prevent the development of endometrial carcinoma, and that hyperestrinism or the unopposed action of estrin is not responsible for such development. It is possible that all endometrial carcinomas do not have the same cause or causes.—*Mary Frances Vastine.*

MAINO, CHARLES R., BRODERS, ALBERT C., and MUSSEY, ROBERT D. Pathology of malignant neoplasm of the cervix coincident with pregnancy. *Am. J. Obst. & Gynec.*, Dec., 1944, *48*, 806–823.

The 26 cases studied represented 0.7 per cent of 3,570 cases of malignant neoplasm in which the patients were admitted to the Mayo Clinic between 1909 and 1941. During this period, 8,500 pregnant women were given obstetric care but, since all of those whose pregnancy was complicated by cancer sought treatment primarily for the malignant condition rather than for obstetric care, the incidence of malignant lesions in this group of pregnant women cannot be estimated.

Of the entire group of 26 patients, in 24 instances a follow-up period of at least five years had elapsed in March, 1944; of these 24, eight were alive and free of recurrence five or more years after the diagnosis was made, a "cure" incidence of 33 per cent.

Twenty-five of the 26 patients had carcinoma of the cervix and 1 patient had myxosarcoma. Of the 25 cases of carcinoma, there were 19 cases of squamous cell epithelioma, 3 cases of adenocarcinoma, 1 case of mixed squamous cell epithelioma and adenocarcinoma, and 2 cases in which the type of carcinoma was not determined.

Bleeding was the primary symptom in nearly

90 per cent of the cases. Among patients in Stage I of the disease, the average duration of symptoms was nine months, as compared with three months for those in Stage IV. Grade 4 lesions were not more frequent in the more advanced cases than in the less advanced cases.

The extent or stage of the lesion corresponded in general to the duration or stage of pregnancy. Seventeen per cent of patients who had Stage I carcinoma, 33 per cent of those in Stage II, 50 per cent of those in Stage III, and 67 per cent of those in Stage IV had full term pregnancies. Five of 8 patients who lived five or more years had squamous cell epithelioma; 3 had adenocarcinoma. Of patients observed for five or more years, 4 of 6 patients who had Stage I carcinoma (66 per cent), 3 of 8 patients in Stage II (38 per cent), 1 patient in Stage III (17 per cent), and no patients in Stage IV, were alive five or more years after the malignant neoplasm of the cervix coincident with pregnancy was diagnosed.—*Mary Frances Vastine.*

Reich, Walter J., and Nechtow, Mitchell J. Cystic pelvic chordoma simulating an ovarian cyst. *Am. J. Obst. & Gynec.*, Feb., 1945, *49*, 265–268.

Chordoma is a tumor which originates in the remnants of the notochord. According to Delafield and Prudden, in man it is a transient, though important, embryologic structure which disappears early in fetal life except for traces remaining in the intervertebral discs (nucleus pulposus). Chordomas may occur anywhere along the spinal cord or develop from the sacrum and coccyx. Both benign and malignant growths have been described in the sacrum.

The morbid anatomy, according to the experiences of Stewart and Morin, varies. Clinically the degree of mucoid degeneration present in a chordoma is an index of its comparative benignancy, the formation of mucin being in inverse ratio to the rate of cellular activity. With increased malignancy, the tumor becomes more and more solid and opaque. One of the most striking features of the chordoma is its locally destructive effects on bone.

Chordoma is usually a tumor of low malignancy, slowly infiltrating and destructive; tends to recur after removal; exceptionally, it may metastasize.

Of the various cases reported by Stewart and Morin the age groups were as follows: 34.9 years in 20 cases of the spheno-occipital region; 50.6 years in the sacrococcygeal cases; the youngest being sixteen years, while the oldest was seventy-two years. Males were in the majority in the ratio of 2:1.

A case report is presented in which a neoplasm which originated in the lower dorsal spine migrated to the pelvis by virtue of a long pedicle. Its presence in the pelvis simulated an ovarian cyst. Only by careful microscopic sections did the diagnosis of chordoma become apparent.—*Mary Frances Vastine.*

GENITOURINARY SYSTEM

Conroy, T. F., and Walker, J. H. Congenital solitary kidney; case reports and consideration of military significance. *J. Urol.*, Jan., 1945, *53*, 4–10.

The incidence of congenital solitary kidney is about 1 in 1,000. Criteria for diagnosis as given by Dourmashkin and Light are as follows; (1) absence of the renal silhouette on the flat film of the abdomen; (2) roentgenological evidence of renal enlargement on the opposite side and possible asymmetry of the psoas muscle shadows; (3) absence of opaque medium on the agenetic side on excretion urography; (4) absence of the ureteral orifice on one side after repeated cystocopic examinations in an otherwise normally appearing bladder, and (5) absence of indigo-carmine elimination on the affected side.

The authors add a sixth criterion, an associated abnormality of the genital tract. They point out diagnostic pitfalls in the above criteria as follows: (1) failure to visualize the renal shadow on one side on a survey film may be due to hypoplasia, destruction by disease, or the presence of overlying shadows in the abdominal cavity; (2) dye excretion may be pervented by renal or ureteral block or by shock or trauma; (3) indigo-carmine is a crude functional index and not reliable.

Conroy and Walker report 2 cases encountered in a military practice. In the first case cystoscopy for a ureteral block suggested the diagnosis which was confirmed by a flat film of the abdomen and excretory urography. In the second case cystoscopic examination was again responsible for the diagnosis which was confirmed by roentgen studies.

The authors conclude that the anomaly is usually a silent one and only recognized when infection or accident to the solitary kidney occurs. Verification of the presence of two functioning kidneys should be a prerequisite to

surgery on the upper urinary tract. The presence of a solitary kidney is no longer considered an adequate cause for rejection from the military service.—*R. M. Harvey.*

WALD, MAURICE H., and GALLOWAY, A. F. Pituitrin for concentrating diodrast in excretion urography. *Radiology*, Oct., 1944, *43*, 358–363.

Posterior pituitary extract has an antidiuretic action and this has beeen utilized in preparing patients for urography. In the tests described here the patients were given 18 ounces of water and an injection of 0.5 cc. (10 units) of pituitrin. The water was given only for the purpose of putting the antidiuretic effect of the the pituitrin to a severe test. The usual procedure would be simply to give the pituitrin one to two hours before the injection of diodrast. But pituitrin may be somewhat dangerous to patient who is already severely dehydrated and in such cases water should be given. The use of the pituitrin results in increased concentration of the diodrast and improved density and detail in the upper urinary tract shadow brought about by its intravenous injection. This technique is of special value when a prompt examination is desired in a patient who has not been dehydrated previously.

The antidiuretic action of pituitrin is probably due to increased reabsorption of water in the proximal convoluted tubules and thin portion of Henle's loop and is accompanied by an increased urinary output of chloride.

A dose of 0.5 cc. pituitrin makes good visualization probable but a smaller dose of 0.2 cc. lessens the probability of unpleasant by-effects from the pituitrin.—*Audrey G. Morgan.*

MISCELLANEOUS

KEMP, L. A. W. Linear radium source dose calculators. *Brit. J. Radiol.*, Oct., 1944, *17*, 300–304.

In some cases unscreened dosage figures are sufficient, and obliquity is ignored when allowing for screenage. In these cases it is possible to obtain dosage figures rapidly by means of a suitable instrument which may be designed in such a way that the combined dosage due to a number of sources in tandem may be found directly by means of it.

Calculators for both screened and unscreened sources are described and illustrated and the formulae on which the calculations are based are given. Isodose curves are given in a plane containing a 25 mg. source, active length 1.9 cm., screenage 1.2 mm. platinum.

The calculator for unscreened sources can be used for a small number of sources in tandem, including ones in which the sources have different line densities. The calculator for screened sources makes use of an electrical method of integration and takes into account both obliquity and non-homogeneity of the radiation. It may be used for one source only or for a number of sources in tandem if the sources have the same line density.—*Audrey G. Morgan.*

SANDLER, BERNARD, and UNGAR, E. M. Geometrical method of dosefinding for radium sources, with special reference to the treatment of carcinoma cervix uteri. *Brit. J. Radiol.*, June, 1944, *17*, 190–196.

Accurate determination of dose distribution of radium and roentgen rays was made possible by Mayneord's dose finder. But it requires a great deal of time and Mayneord himself says that rapid methods of three-dimensional dose studies are urgently required. This is particularly true when intracavitary radium is to be supplemented later by external roentgen radiation in the treatment of carcinoma of the cervix. A method of roentgen-ray distribution must be found that will compensate for the gradual fall in radium dosage toward the wall of the pelvis. Such a method is described, based on solid projection geometry. The method of geometric reconstruction and obtaining true projections is described in detail and illustrated with diagrams, a study of which would be required for adequate understanding of the method.—*Audrey G. Morgan.*

RAYMOND C. BEELER
President of the American Roentgen Ray Society
1946–1947